

UNIVERSITY OF ENGINEERING AND MANAGEMENT, JAIPUR

Lecture-wise Plan

Subject Name: Principles of Computer Programming-(C++)

Subject Code- CS201

Year: 1st year

Semester: Second

Module Number	Topics	Number of Lectures
1	Introduction to Object-oriented Programming concept	2L
	1. Procedure-oriented Programming, Object-oriented Programming Paradigm	1
	2. Basic concepts of Object-oriented programming, Benefit of OOP	1
2	Beginning with C++	2L
	1. What is C++? A simple C++ program, An example with class	1
	2. Structure of C++ program, tokens, keywords, identifiers and constants, data types, reference variables, scope resolution operator	1
3	Functions in C++	3L
	1. Main function, function prototyping, call by reference,	1
	2. Inline functions and friend functions.	1
	3. Concept of Function overloading	1
4	Classes and Objects	5L
	1. Specifying a class, defining member functions	1
	2. A C++ program with class	1
	3. Making an Outside Function inline	1
	4. Static data members	1
	5. static member functions	1
5	Constructors and Destructors	5L
	1. Constructors, default Constructors	1
	2. Multiple constructors in a class	1
	3. parameterized constructor	1
	4. copy constructor	1
	5. Destructor	1
6	Inheritance	6L
	1. Defining Derived classes ,single inheritance	1
	2. multilevel inheritance ,multiple inheritance	1
	3. hierarchical, hybrid inheritance	2
	4. virtual base classes, abstract classes	1
	5. constructor in derived classes	
	Operator overloading	7L
	1. Defining Operator overloading, rules for overloading operators	1
	2. Overloading unary operators using	1

7	member function	
	3. Overloading of unary operator with friend function.	1
	4. Overloading Binary operators using member function	1
	5. Overloading Binary operators using friends, Examples.	1
	6. Type conversion	2
8	Polymorphism	7L
	1. Concept of polymorphism, runtime polymorphism, compile time polymorphism	1
	2. Pointers, Pointers to objects	1
	3. this pointer	1
	4. Function overloading with an example(Program)	1
	5. Function overriding with a proper example	1
	6. Virtual function; Pure Virtual function	1
	7. Abstract class	1
9	Exception Handling	8L
	1. Introduction, Basics of Exception Handling	2
	2. Exception Handling mechanism	2
	3. Throwing and catching mechanism	2
	4. Rethrowing an Exception	2
Total Number Of Lectures = 45		

Faculty In-Charge

HOD, CSE Dept.

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Assignment:

Module-I: Introduction to Object-oriented Programming concept

1. What do you mean by procedural oriented programming language? What are the main characteristics of procedural oriented language?
2. Write a brief description about object oriented programming language? What are the benefits that we are getting by using object oriented programming language?

Module-II: Beginning with C++

1. What is cascading in C++? Describe cascading with help of small program? Briefly describe the significance of insertion and extraction operator with the help of example?
2. "Is C++ really a 100% object oriented programming language". Give an appropriate reason to support your answer? Describe why we need to include iostream.h header file in C++ program?

Module-III: Functions in C++

1. "Is friend function really violates the data security of a program" Explain it with appropriate reason?
2. What do you mean by Inline function? Explain it with the help of example?

Module-IV: Classes and Objects

1. How to design a class in C++? Explain it with an example? Explain how the memory allocation takes place for a C++ program? Describe it with example? What are objects in C++?
2. What do you mean static data members? Explain it with example? Describe the properties of static data member with the help of example?

Module-V: Constructors and Destructors:

1. What do you mean by default constructor? Explain it with an example? Explain how do we invoke constructor function in a C++ program? Explain when default destructor is used to destroy the objects?
2. What do you mean by parameterized Constructor? Explain it with the help of example? Explain with an example how the data member of a class is initialized by using parameterized Constructor?

Module-VI: Inheritance

1. What do you mean by mode of inheritance? Explain it with the help of an example? Explain how protected access specifier is used in case of an inheritance?
2. What do you mean by multilevel inheritance? Explain it with an example as well as suitable diagram? Write a program to demonstrate multilevel inheritance in C++?

Module-VII: Operator overloading

1. Write a C++ program by using class to overload ++ operator? Write a program in C++ to overload > operator by using member function.

2. Write a program in C++ that will input the details of ten students. User will supply the roll of the student, on the basis of the roll number; the entire details of the student will be displayed on the output screen. Write the program by using class.

Module-VIII: Polymorphism

1. What do we need virtual function? Describe it with an example?
2. When do we make a virtual function pure? Write a program by using class that contains two data members, initialize it with a member function and interchange the value of data members by using static member function.

Module-IX: Exception Handling

1. How we can restrict a function to throw only certain specified exception in C++. Explain with proper example. Write a C++ program to implement the concept of rethrowing mechanism.
2. Write a C++ program where you can pass more than one parameters.

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Lecture-wise Plan

Subject Name: Physics-II

Subject Code-PH201

Year: 1st Year

Semester: Second

MODULE	<u>TOPIC</u>	LECTURE
1	Module 1: Vector Calculus Physical significances of grad, div, curl. Line integral, surface integral, volume integral- physical examples in the context of electricity and magnetism and statements of Stokes theorem and Gauss theorem [No Proof]. Expression of grad, div, curl and Laplacian in Spherical and Cylindrical co-ordinates.	8
	Assignments based on above	
2	Module 2: 2.1 Electricity:: Coulombs' law in vector form. Electrostatic field and its curl. Gauss's law in integral form and conversion to differential form. Electrostatic potential and field, Poisson's Eqn. Laplace's eqn (Application to Cartesian, Spherically and Cylindrically symmetric systems - effective 1D problem) Electric current, drift velocity, current density, continuity equation, steady current. 2.2 Dielectrics-concept of polarization, the relation $D=\epsilon_0 E+P$, Polarizability. Electronic polarization and polarization in mono-atomic and poly-atomic gases.	12
	Assignments based on above	
3	Module 3: Magneto-statics & Time Varying Field: Lorentz force, force on a small current element placed in a magnetic field. Biot-Savart's law and its applications, divergence of magnetic field, vector potential, Ampere's law in integral form and conversion to differential form. Faraday's law of electro-magnetic induction in integral form and conversion to differential form.	8
	Assignments based on above	
4	Module 4: Electromagnetic Theory Concept of displacement current Maxwell's field equations, Maxwell's wave equation and its solution for free space. E.M. wave in a charge free conducting media, Skin depth, physical significance of Skin Depth, E.M. energy flow, & Poynting Vector.	6
	Assignments based on above	
5	Module 5: Quantum Mechanics 5.1 Generalized coordinates, Lagrange's Equation of motion and Lagrangian, generalized force potential, momenta and energy. Hamilton's Equation of motion and Hamiltonian. Properties of Hamilton and Hamilton's equation of motion. Course should be discussed along with physical problems of 1-D motion 5.2 Concept of probability and probability density, operators, commutator. Formulation of quantum mechanics and Basic postulates, Operator correspondence, Time dependent Schrödinger's equation, formulation of time independent Schrödinger's equation by method of separation of variables, Physical interpretation of wave function ψ (normalization and probability interpretation), Expectation values, Application of Schrödinger equation - Particle in an infinite square well potential (1-D and 3-D potential well), Discussion on degenerate levels.	8
	Assignments based on above	
	Total Lectures Required	42

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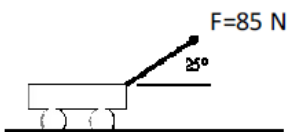
Lecture-wise Plan

ASSIGNMENTS

UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

B.Tech. 2nd Semester – Assignment No.1 – PH-201 – Engineering Physics

1. Define the following:
(a) Scalar (b) vector (c) polar and axial vector (d) null vector (e) unit vector (f) null vector (g) collinear vector (h) coplanar vector (i) direction cosines.
2. Find the angle between face diagonal of a cube.
3. Find the angle between body diagonal of a cube.
4. Show that $(\vec{A} \times \vec{B})$ represent area of a parallelogram.
5. Show that $(\vec{A} \times \vec{B}) \cdot \vec{C}$ represent area of a parallelepiped.
6. Find 'a' such the vectors $2\hat{i} - \hat{j} + \hat{k}$, $\hat{i} + 2\hat{j} - 3\hat{k}$ and $3\hat{i} + a\hat{j} + 5\hat{k}$ are coplanar.
7. Check whether the following vectors are coplanar or not. $\vec{u} = \hat{i} + 5\hat{j} - 2\hat{k}$, $\vec{v} = 3\hat{i} - \hat{j}$, and $\vec{w} = 5\hat{i} + 9\hat{j} - 4\hat{k}$.
8. If $\vec{A} \times (\vec{B} \times \vec{C}) = (\vec{A} \times \vec{B}) \times \vec{C}$, show that $(\vec{A} \times \vec{C}) \times \vec{B} = 0$.
9. If $\vec{A} = \hat{i} - 2\hat{j} - 3\hat{k}$, $\vec{B} = 2\hat{i} + \hat{j} - \hat{k}$, $\vec{C} = \hat{i} + 3\hat{j} - \hat{k}$, find $\vec{A} \times (\vec{B} \times \vec{C})$.
10. A particle is acted upon by constant forces $(5\hat{i} + 2\hat{j} + \hat{k})$ and $(2\hat{i} - \hat{j} - 3\hat{k})$ and is displaced from the origin to the point $(4\hat{i} + \hat{j} - 3\hat{k})$. Calculate the total work done by the forces.
11. A wagon is pulled as shown below. Determine the horizontal and vertical components of the force.



12. If $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$, then show that \vec{A} and \vec{B} are perpendicular to each other.
13. Prove that $(\vec{A} \times \vec{B})^2 = A^2 B^2 - (\vec{A} \cdot \vec{B})^2$
14. If $(\vec{A} \times \vec{B}) = \vec{C}$, $(\vec{B} \times \vec{C}) = \vec{A}$, $(\vec{C} \times \vec{A}) = \vec{B}$, show that $\vec{A}, \vec{B}, \vec{C}$ are mutually perpendicular.
15. For what value of c are the vectors $(c, 1, 1)$ and $(-1, 2, 0)$ perpendicular?
16. If $\vec{A} = (2, 0, 3)$ and $\vec{B} = (1, 0, -1)$, what is the angle between the vectors \vec{A} and \vec{B} .
17. If $\vec{A} = \hat{i} - 2\hat{j} - 3\hat{k}$, $\vec{B} = 2\hat{i} + \hat{j} - \hat{k}$, then find a unit vector normal to both \vec{A} and \vec{B} .
18. Find the direction cosines of the vector \vec{A} : Given $\vec{A} = 3\hat{i} - \hat{j} + 4\hat{k}$.
19. A cart is pulled a distance of 50m along a horizontal path by a constant force of 25 N. The handle of the cart is pulled at an angle of 60° above the horizontal. Find the work done by the force.
20. A bolt is tightened by applying a 40-N force to a 0.25-meter wrench. Find the magnitude of the torque about the center of the bolt. The angle between the axis of rotation and the force is 75° .

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Lecture-wise Plan

UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

B.Tech. 2nd Semester – Assignment No.2 – PH-201 – Engineering Physics

1. Give conditions with example for (i) solenoidal fields (ii) irrotational fields (iii) incompressible liquids (iv) solenoidal but not irrotational fields (v) irrotational but not solenoidal fields (vi) neither solenoidal nor irrotational fields.
2. Find the unit vector perpendicular to $4x^2 + 3y^2 + 2z^2 = 50$ at the point (2,3,5).
3. Show that $\vec{\nabla} \cdot \vec{v} = 0$, where $\vec{\omega}$ is a constant vector, \vec{r} is the position vector and $\vec{v} = \vec{\omega} \times \vec{r}$.
4. If $\vec{v} = \vec{\omega} \times \vec{r}$, prove $\vec{\omega} = \frac{1}{2}(\vec{\nabla} \times \vec{v})$ where $\vec{\omega}$ is a constant vector.
5. Find the angle between the surfaces $x^2 + y^2 + z^2 = 5$ and $x^2 + y^2 - z = 7$ at the point (-2,1,1).
6. Find the directional derivative of $\phi_{(x,y,z)} = xy^2z + 4xz^2$ at (-2,1,1) in the direction $2\hat{i} + \hat{j} + 2\hat{k}$.
7. For a scalar function $\phi = \left(\sin \frac{\pi x}{2} \sin \frac{\pi y}{3}\right) e^{-z}$ calculate the magnitude and direction of maximum rate of increase of ϕ at the point (1,1,1).
8. In what direction from the point (-2,1,1) is the directional derivative $\phi_{(x,y,z)} = 2xz - y^2$ is maximum? What is the magnitude of this maximum?
9. A vector field is given as $\vec{W} = 4x^2y\hat{i} - (7x + 2z)\hat{j} + (4xy + 2z^2)\hat{k}$
 - (i) What is the magnitude of the field at point (2,-3,4)?
 - (ii) At what point on z-axis is the magnitude of W equal to unity?
10. If vectors \vec{A} and \vec{B} are irrotational then show that vector $\vec{A} \times \vec{B}$ is solenoidal.
11. Evaluate $\vec{\nabla} \cdot \frac{\vec{r}}{r^3}$.
12. Evaluate $\vec{\nabla} \times \frac{\vec{r}}{r}$.
13. Prove that $\vec{\nabla}^2 \ln r = \frac{1}{r^2}$.
14. Find the constant m such that the vector $\vec{F} = (x + 3y)\hat{i} + (y - 2z)\hat{j} + (x + mz)\hat{k}$ is solenoidal.
15. Show that $\vec{F} = (2xy + z^3)\hat{i} + x^2\hat{j} + 3xz^2\hat{k}$ is conservative force field.
16. Find the constants a,b, c so that $\vec{A} = (x + 2y + az)\hat{i} + (bx - 3y - z)\hat{j} + (4x + cy + 2z)\hat{k}$ is irrotational.

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Lecture-wise Plan

UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

B.Tech. 2nd Semester – Assignment No.3 – PH-201 – Engineering Physics

1. Calculate the work done in moving a particle in a force field given by $\vec{F} = 2xy\hat{i} - 4z\hat{j} + 8y\hat{k}$ along the curve $x=t^2+1, y=t^2, z=t^3$ from $t=0$ to $t=1$.
2. Calculate the work done in moving a particle in a force field given by $\vec{F} = xy\hat{i} - yz\hat{j} + xz\hat{k}$ along the curve $\vec{r} = t\hat{i} + t^2\hat{j} + t^3\hat{k}$ where t varies from -1 to 1.
3. If $\vec{B} = \vec{\nabla} \times \vec{A}$, show that $\oint \vec{B} \cdot d\vec{S} = 0$ for any closed surface.
4. Find $\oint \vec{r} \cdot d\vec{S}$ where the surface S encloses a volume V and \vec{r} is the position vector of any point on this surface.
5. Given Point $P(x=3, y=2, z=-1)$ and $Q(r=2, \theta=30^\circ, \phi=60^\circ)$, Evaluate (i) Spherical Coordinates of P
(ii) Cartesian Coordinates of Q
6. Express the vector $\vec{A} = 3xy\hat{i} - 5(x+z)\hat{k}$ in spherical coordinates and evaluate it at $(2, 30^\circ, 60^\circ)$.
7. Express the vector $\vec{A} = 3xy\hat{i} - 5(x+z)\hat{k}$ in cylindrical coordinates and evaluate it at $(2, 60^\circ, 3)$.
8. Find out the volume element in Cartesian, spherical and cylindrical co-ordinate system.
9. The volume charge density in a region is given by $\rho = 40xyz$ Coulomb/m³. Find the total charge density within the region bounded by $x=0, y=0, 0 \leq 2x+3y \leq 10$ and $0 \leq z \leq 2$.
10. An electric Field intensity is given as $\vec{E} = 10 \cos \theta \frac{q}{r^3} \hat{r} + 5 \sin \theta \frac{q}{r^3} \hat{\theta}$ then
 - (i) Find $|E|$ at $r=2, \theta=60^\circ, \phi=20^\circ$
 - (ii) Unit vector in direction of \vec{E}
 - (iii) Unit vector in Cartesian coordinates in direction of \vec{E} .

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UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

B.Tech. 2nd Semester – Assignment No.4 – PH-201 – Engineering Physics

Coulomb's Law

- (i) State and explain Coulomb's law in electrostatics.
 - (ii) Express it mathematically with meaning of each symbol for two point charges.
 - (iii) Does it depend on the medium property? If yes, then answer, how?
 - (iv) What is the most important requirement for the validity of Coulomb's law?
 - (v) Show that gravitational force can be neglected when compared with Coulomb's force.
- The electrostatic force on a small sphere of charge $0.4\mu\text{C}$ due to another small sphere of charge $-0.8\mu\text{C}$ in air is 0.2N . (a) What is the distance between the two spheres? (b) What is the force on second sphere due to the first?
- Dielectric constant of water is 81. Determine the electrical permittivity of water. Two point charges 10^{-7}C and $2 \times 10^{-7}\text{C}$ are placed 10 cm apart. If the intervening medium between them be (i) air (ii) water, then determine the mutual force of repulsion between them.
- A charge q is placed at the centre of the line joining two equal charges Q . Find q in terms of Q , so that the system of three charges will be in equilibrium.
- Two point charges q , $2q$ are kept at a distance d apart in air. A third charge Q is to be kept along the same line in such a way that the net force acting on q and $2q$ is zero. Calculate the position and value of Q in terms of q and d .
- Two point charges Q and q are placed at a distance x and $x/2$ respectively from a third charge $4q$. All the three charges are on the same straight line. Calculate Q in terms of q such that the net force on q is zero.
- Four equal charges $+q$ are placed at the corner of a square. Find the point charge at the centre of the square so that the system will remain in equilibrium.
- Consider three charges each equal to q at the vertices of an equilateral triangle of side l . What is the force on a charge Q (same sign as q) placed at the centroid of the triangle?
- An amount of charge Q is divided into two particles. Find the charge on each particle so that the effective force between them will be maximum.
- Force of attraction between two point charges placed at a distance ' d ' apart in a medium is ' F '. What would be the distance apart in the same medium so that the force of attraction between them becomes $F/3$?
- Consider the charges q , q and $-q$ placed at the vertices of an equilateral triangle. What is the force on each charge?

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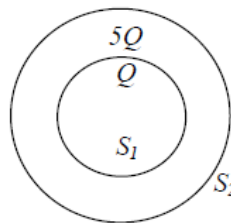
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UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

B.Tech. 2nd Semester – Assignment No.5 – PH-201 – Engineering Physics

Electric field, Electric potential and Electric flux

- (i) Define electric field \vec{E} and electric potential V at a point and how they are related.
(ii) Why electric field intensity is called conservative field?
(iii) Show that $\vec{\nabla} \times \vec{E} = 0$
(iv) What is the unit of electric field intensity and electric potential?
(v) In a place the electric potential is same everywhere. What is your understanding about the electric field intensity in that place?
(vi) Find the potential and hence the electric field due to (a) a uniformly charged rod (b) uniformly charged ring (c) uniformly charged disc.
- (i) What is electric flux? Define it.
(ii) What is the total flux across a closed surface due to a charge kept outside the surface?
- Check whether the field $\vec{E} = 4y\hat{i} - 2x\hat{j} + \hat{k}$ is conservative or non-conservative?
- If $\vec{E} = q / (4\pi\epsilon_0 r^2) \hat{r}$, then show that \vec{E} is solenoidal
- If the potential in the region of space near the point (-2m, 4m, 6m) is $V = 80x^2 + 60y^2$ volt, what are the three component of electric field at that point?
- In an electric field the electric potential is given by $V(x,y,z) = 2x^2 + 4y^2 + 3z^2$. Find the electric field at point (1,1,1).
- The electric potential in the region of space is found to depend on x only and is given by $V = ax - bx^3$ where a and b are constants. Find the position on the x -axis where the electric field is zero.
- The electric potential $V(x)$ in a region along the x -axis varies with distance x (in meter) according to the relation $V(x) = 4x^2$. Calculate the force experienced by 1 mC charge placed at point $x = 1$ m.
- Given the potential $V = \frac{10}{r^2} \sin \theta \cos \phi$. Find electric flux density \vec{D} at $\left(2, \frac{\pi}{2}, 0\right)$
- In a region of space the electric field is given by $\vec{E} = 8\hat{i} + 4\hat{j} + 3\hat{k}$. Calculate the electric flux through a surface of 100 units in XY -plane.
- S_1 and S_2 are two hollow concentric spheres enclosing charges Q and $5Q$ respectively. What is the ratio of electric flux through S_1 and S_2 ?



- Find the electric flux through each face of a unit cube due to a charge q coulomb placed at (i) centre
(ii) one of the vertices.

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B.Tech. 2nd Semester – Assignment No.6 – PH-201 – Engineering Physics

Gauss's law, Poisson's Equation, Laplace's Equation

- (i) State and explain Gauss' law in electrostatics.
 - (ii) What are the limitations of Gauss' law.
 - (iii) Derive Coulomb's law from Gauss' law.
 - (iv) Write down the differential and integral form of Gauss's law.
 - (v) If Coulomb's law involved $1/r^3$ dependence instead of $1/r^2$, would Gauss' law be still true?
 - (vi) Using Gauss' law find the electric field intensity outside, inside and on the surface of (a) uniformly charged sphere (b) hollow charged sphere (c) uniformly charged cylinder (d) hollow charged cylinder. Also show the graphical representation.
 - (vii) Applying Gauss' law determine the electric field intensity due to (a) long thin wire of uniform charge distribution (b) infinitely plane sheet of charge.
 - (viii) The amount of net charge enclosed by a net surface is known, but there is no idea about the distribution of charges. In this case, can Gauss' law be applied to determine the electric field intensity at any point of closed surface? Explain.
- (i) Extend Gauss' law to Poisson's equation. When does it reduce to Laplace's equation.
 - (ii) Write down Laplace's equation in Cartesian co-ordinate system. Two infinite parallel plates at $z=0$ and $z=a$ are maintained at potentials V_0 and V_a respectively. Obtain the variation of potential and field between the plates.
 - (iii) Write down Laplace's equation in Spherical co-ordinate system and find the solution for spherical capacitor considering the variation of potential along radial direction.
 - (iv) Write down Laplace's equation in Cylindrical co-ordinate system and find the solution for cylindrical capacitor considering the variation of potential along radial direction.
- A spherical shell of inner radius r_1 and outer radius r_2 is uniformly charged with charge density ρ . Calculate the electric field at a distance r from the centre of the spherical shell for (a) $r > r_2$ (b) $r_1 < r < r_2$ (c) $r < r_1$.
- Find the total charge contained within a sphere of radius 'r' where volume charge density is proportional to radius of the sphere.
- In cylindrical co-ordinate the electric flux density is given by $\vec{D} = z\rho \cos^2 \phi \hat{z}$ C/m². Calculate the charge density at $\left(1, \frac{\pi}{4}, 3\right)$ and the total charge enclosed by the cylinder of radius 1 meter with $-2 \leq z \leq 2$ meter.
- Find the charge density due to an electric field given by $\vec{E} = 2/(\epsilon_0 r) \hat{r}$ V/m.
- Show that the potential $V = x^2 - y^2 + z$ satisfies Laplace's equation.
- The potential at any point in free space is given by $V = 5x^2y + 3yz^2 + 6xz$ volt, where x, y, z are in meters. Calculate the volume charge density at point (2,5,3) m.
- Given the potential $V = \frac{10}{r^2} \sin \theta \cos \phi$. Find the work done in moving a $-10\mu\text{C}$ charge from point $A(1, 30^\circ, 120^\circ)$ to $B(4, 90^\circ, 60^\circ)$.
- Calculate the potential at the centre of a spherical charge distribution given by
$$\rho = \rho_0 r \quad r \leq R$$
$$= 0 \quad r > R$$
- An infinite line charge produces a field of 9×10^4 N/C at a distance of 2 cm. Calculate the linear charge density.
- Two large thin metal plates are parallel and close to each other. On their inner faces, the plates have surface charge densities of opposite sign and magnitude 17×10^{-22} C/m². What is the electric field (a) in the outer region of 1st plate (ii) in the outer region of 2nd plate (iii) between the plates?

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UNIVERSITY OF ENGINEERING & MANAGEMENT, JAIPUR

B.Tech. 2nd Semester –Assignment No.7–PH-201–Engineering Physics

Dielectrics

- 8
- (i) Define electronic polarizability and Show that $\alpha = \frac{\epsilon_0(\epsilon_r - 1)}{N}$.
 - (ii) Show that $\mathbf{D} = \epsilon_0 \mathbf{E} + \mathbf{P}$.
 - (iii) What happens when a non-polar molecule is placed in an electric field?
- 13
- a. A dielectric material contains 2×10^9 polar molecules/m³ each of dipole moment 1.8×10^{-27} cm. Assuming that all of the dipoles are aligned towards electric field $E = 10^5$ V/m. Find the polarization, electric susceptibility and the relative permittivity.
 - b. The dielectric constant of helium at 0°C is 1.0000684. If the gas contains 2.7×10^{25} atoms/m³, find the radius of the electron cloud.

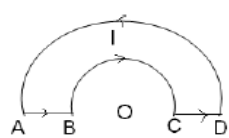
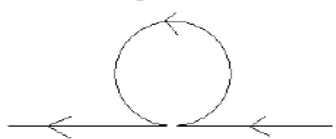
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B.Tech. 2nd Semester –Assignment No.8–PH-201–Engineering Physics

Magnetostatics and Time Varying Fields

1	<p>a. Write the condition of steady state current using equation of continuity and show that Ampere's law implies that the current is in the steady state?</p> <p>b. Show that Lorentz magnetic force does no work.</p>
2	<p>a. Using Biot-Savart's law, calculate the magnetic field of induction due to a long straight wire</p> <p>b. Show that the field at the end of a long current carrying solenoid is half that of at the centre.</p>
3	<p>a. Deduce differential form of Ampere's circuital law and hence prove that the static magnetic field is not conservative.</p> <p>b. Applying Ampere's law find the magnetic field due to a long straight current carrying solid cylinder. Draw the necessary diagram explaining the variation of magnetic field with distance.</p>
4	<p>a. What do you mean by magnetic scalar potential and magnetic vector potential?</p> <p>b. If the vector potential $\vec{A} = (10x^2 + y^2 - z^2)\hat{j}$ at any position, then find the (i) magnetic field at that position (ii) magnetic field at the point (1,1,1).</p>
5	<p>a. Find the magnetic field at the center of (a) an equilateral triangular loop and (b) square loop both having side a and carrying current I.</p> <p>b. Two wires carrying current in the same direction of 5,000 A and 10,000 A are placed with their axis 5 cm apart. Calculate the force between them. Justify whether the force is of repulsion or attraction type.</p>
6	<p>a. A circular current carrying coil has a radius R. Show that the distance from the centre of the coil, on the axis, where B will be (1/8) of its value at the centre of the coil is ($\sqrt{3}r$).</p> <p>b. A straight wire 0.5m long carries a current of 100A and lies at right angles to a uniform field of 1.5T. Find the mechanical force on the conductor when it lies in a position such that it is inclined at an angle of 30° to the direction of field.</p>
7	<p>If a charged particle of charge 0.4 C is moving with a velocity $4\hat{i} - \hat{j} + 2\hat{k}$ m.s⁻¹ through an electric field $\vec{E} = 10\hat{i} + 10\hat{k}$, and magnetic field of induction $\vec{B} = 2\hat{i} - 16\hat{j} - 6\hat{k}$, then find (i) the force experienced by the particle in electric field (ii) the force experienced in magnetic field and (iii) Lorentz force.</p>
8	<p>a. Two wire loops ABCDA formed by joining two semi circular wires of radii R1 and R2 carries a current I as shown in figure. Find out the magnetic field at centre O.</p>  <p>b. The wire shown in figure carries a current I. What will be the magnitude and direction of magnetic field at the centre?</p> 
9	<p>a. Consider a coaxial cable which consists of an inner wire of radius a surrounded by an</p>

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	<p>outer shell of inner and outer radii b and c respectively. The inner wire carries a current i and outer shell carries equal current but in opposite direction. Find the magnetic field at a distance r, where (i) $r < a$ (b) $a < r < b$ (iii) $b < r < c$ (iv) $r > c$.</p> <p>b. Calculate the magnetic field intensity just outside and inside of a hollow cylinder of radius 4 cm carrying current 50 A.</p>
10	<p>a. Two circular coils each of radius 6cm and 60 turns are separated by a distance of 16 cm along their common axis. Find the strength of the magnetic field of induction at a point midway between them on their common axis when a current of 0.1 A is passing through them in anticlockwise direction.</p> <p>b. Calculate the magnetic field intensity along the axis of a solenoid carrying a current of 3 A. The length of the solenoid is 1.5 m and the total number of turns is 1500.</p>

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B.Tech. 2nd Semester –Assignment No.9–PH-201–Engineering Physics

Electromagnetic Field Theory

- 1 a. State Faraday's law of electromagnetic induction and express it in differential and integral form.
b. Show that Ampere's law is insufficient for time varying field. Hence find the modified form of Ampere's law.
c. Define displacement current.
- 2 a. Write down Maxwell's equation with statements in differential form and explain physical significance of each.
b. From differential form of Maxwell's equations obtain the integral form.
- 3 Write down Maxwell's equation for the following cases (a) free space or vacuum (b) good conducting medium (c) conducting medium (d) dielectric medium (v) static field.
- 4 a. Write down Maxwell's equation in differential form in free space. From these equations derive the wave equation for an electromagnetic wave. What is the velocity of this wave?
b. Show that in free space the velocity of electromagnetic wave is equal to the velocity of light in vacuum.
c. Write down Maxwell's wave equation for electric and magnetic field. Find its solution. Prove that the electric field and magnetic field are perpendicular to the direction of propagation of electromagnetic wave.
d. Prove that electromagnetic wave is transverse in nature.
e. Show that electric field intensity, magnetic field intensity and the propagation vector constitute a right hand orthogonal system
- 5 a. Write down Maxwell's equation in charge free conducting medium. Find solution of these in conducting medium.
b. Show that the electromagnetic wave attenuates as it propagates through a conducting medium.
c. Define skin depth. What is the effect of frequency on skin depth?
d. Show that the speed of electromagnetic wave in ideal dielectric is less than the speed of light in vacuum.
- 6 a. What is Poynting vector? What is its physical significance? Give statement of Poynting theorem.
b. Show that Poynting vector measures the flow of energy per unit time per unit area in an electromagnetic wave.
7. A metal bar slides without friction on two parallel conducting rails at distance r apart. A resistor R is connected across the rails and a uniform magnetic field B , pointing into this plane fills the entire region. If the bar moves to the right at a constant speed v then what is the current in the resistor?
8. A rectangular loop of sides 8 cm and 2 cm having resistance of 1.6Ω is placed in a magnetic field of 0.3 Tesla directed normal to the loop. The magnetic field is gradually reduced at the rate of 0.02 T/s. Find the induced current.
9. A parallel plate capacitor with circular plates of 10 cm radius separated by 5 mm is being charged by an external source. The charging current is 0.2 A. Find the (i) the rate of change of potential difference between the plates and (ii) obtain the displacement current.
10. An alternating field $E = E_0 \sin \omega t$ is applied to a conductor (conductivity $\sim 10^{10}$ mho/m). Show that the displacement current is negligible as compared to the conduction current at any frequency lower than the optical frequency.

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11. An ac voltage source is connected across the two plates of an ideal parallel plate capacitor. If the applied ac voltage $V = V_0 \sin \omega t$, then verify that the displacement current in the ideal capacitor is equal to the conduction current through the wire.
12. A plane e-m wave whose electric field is given by $\mathbf{E} = 24 \sin(\pi \times 10^7 t - 0.5\pi z)$ V/m travels in a perfect dielectric. Find its velocity and the corresponding magnetic field.
13. The electric field of a plane e-m wave in vacuum is given by
$$E_x = E_z = 0, E_y = 0.5 \cos \left[2\pi \times 10^8 \left(t - \frac{x}{c} \right) \right].$$
(i) What is the direction of wave propagation? (ii) What is the associated wave length? (iii) Calculate the components of magnetic field associated with the wave.
14. Show that for frequency $\leq 10^9$ Hz, a sample of silicon will act like a good conductor. For silicon, assume $\frac{\epsilon}{\epsilon_0} = 12$ and $\sigma = 2$ mho/cm. Also calculate the penetration depth for this sample at frequency 10^6 Hz.
15. The earth is considered to be a good conductor when $\frac{\omega \epsilon}{\sigma} \ll 1$. Calculate the highest frequencies for which the earth can be considered a good conductor if $\ll 1$ means less than 0.1. Assume $\sigma = 5 \times 10^{-3}$ mho/m and $\epsilon = 10\epsilon_0$.
16. Calculate the value of Poynting vector for a 60W lamp at a distance 0.5 m from it.
17. Calculate the value of Poynting vector at the surface of the sun if the power radiated by the sun is 3.8×10^{26} W and its radius is 7×10^5 km.
18. Calculate the skin depth for radio waves of 3 m wavelength (in free space) in copper, the electrical conductivity of which is 6×10^7 S/m.
19. Find the magnetic field B and Poynting vector P of electromagnetic waves in free space if the components of electric fields are $E_x = E_y = 0$ and $E_z = E_0 \cos kx \sin \omega t$.
20. Find the skin depth δ at a frequency 1.6 MHz in Aluminium where $\sigma = 38.2 \times 10^6$ mho.m⁻¹ and $\mu = 4\pi \times 10^{-7}$ henry.m⁻¹.
21. In an electromagnetic wave propagation through a medium of relative permittivity 4 and relative permeability 1, then calculate the velocity of the wave.
22. An electromagnetic wave enters a medium having relative permittivity 8 and relative permeability 1 and conductivity 0.25 pS/m. Check whether the medium is acting as a good conductor or not if the frequency of the wave is 1.6 MHz. Determine the propagation vector, wave length and the velocity of the electromagnetic wave.
23. The electric field and magnetic field of a plane electromagnetic wave are given by $E_z = A \cos \omega x \cos \omega t$ and $H_y = -A \sin \omega x \sin \omega t$. Calculate the instantaneous value of Poynting vector and average value of Poynting vector.

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Assignment 10 - STATISTICAL MECHANICS

- 1 What do you mean by (a) macro state (b) microstate (c) ensemble (d) micro canonical ensemble (e) canonical ensemble (f) grand canonical ensemble (g) thermodynamic probability (h) phase space.
- 2 a. Calculate the total no. of macrostate and microstate of a system consisting of ϵ , 2ϵ and 3ϵ energy states with total energy 4ϵ and two distinguishable particles.
b. Three distinguishable particles each of which can be accommodated in energy states E , $2E$, $3E$, $4E$ with total energy $6E$. Find all the possible number of distributions. Also find total microstates in each case.
- 3 a. Distribute three particles in two different states according to (i) MB (ii) BE (iii) FD statistics.
b. You are given with two particles and a three compartment box. Find the ratio of the occupation probability of the two particles in the same state to the occupation probability of the particles in different states assuming the particles as (i) Boltzons (ii) bosons (iii) Fermions.
c. A system with non-degenerate single particle state with 0,1,2,3 energy units. Three particles are to be distributed in three states so that the total energy of the system is 3 units. Find the number of microstates if particles obey (i) MB statistics (ii) FD statistics.
- 4 a. Write down basic postulates of MB, BE and FD statistics. Compare MB, BE and FD statistics according to their particle nature, spin, wave function, no. of particles in a state, energy distribution and thermodynamic probability.
b. Give examples of boltzons, bosons and fermions.
- 5 a. Discuss Fermi distribution function with graphical representation at zero and non zero temperature.
b. Show that at absolute zero temperature the no of fermions per unit volume within energy range ϵ to $\epsilon + d\epsilon$ is proportional to $\epsilon^{1/2}$.
c. Find the total number of particles in a metal at absolute zero. From this expression also calculate Fermi energy.
d. Show that the average electron energy is $\bar{E} = \frac{3}{5} E_f(0)$, where $E_f(0)$ is Fermi energy at absolute zero.
- 7 Use BE statistics to obtain Planck's radiation formula for black body radiation.
- 8 a. The Fermi energy for sodium at $T=0K$ is 3.1 eV. Find its value for aluminium. Given that the free electron density in aluminium is approximately 7 times that in sodium.
b. If the Fermi energy of a metal at thermal equilibrium is 15 eV, then find the average energy of the electron.
c. Find the electron concentration of silver atom with atomic weight 108 and number of free electron per atom as one and Fermi energy 4.5 eV at 0 K.
d. Calculate Fermi energy at 0K of metallic silver containing one free electron per atom. The density and atomic weight of silver is 10.5 g/cm^3 and 108 g/mol respectively.
e. Calculate the Fermi energy in copper. Consider density of copper as $8.94 \times 10^3 \text{ kg/m}^3$ with atomic mass 63.5 amu.
f. There are about 25×10^{28} free electrons/ m^3 in sodium. Calculate its Fermi energy at 0K.

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Subject Name: Mathematics-II
Year: 1st Year

Subject Code-M201
Semester: Second

Module Number	Topics	Number of Lectures
1	Ordinary differential equations (ODE)	7L
	First order and first degree: Exact equations, Necessary and sufficient condition of exactness of a first order and first degree ODE (statement only)	1
	Rules for finding Integrating factors	2
	Linear equation, Bernoulli's equation	2
	General solution of ODE of first order and higher degree (different forms with Clairaut's equation)	2
2	ODE- Higher order and first degree:	7L
	General linear ODE of order two with constant coefficients, C.F. & P.I., D-operator methods for finding P.I.	4
	Method of variation of parameters	1
	Cauchy-Euler equations	1
	Solution of simultaneous linear differential equations	1
3.	Basics of Graph Theory:	4L
	Graphs, Digraphs, Weighted graph, Connected and disconnected graphs, Complement of a graph	1
	Regular graph, Complete graph, Subgraph, Walks, Paths, Circuits, Euler Graph, Cut sets and cut vertices, Bipartite graph	1
	Matrix representation of a graph, Adjacency & incidence matrices, Graph isomorphism	2
4	Tree:	6L
	Definition and properties, Binary tree, Spanning tree of a graph, Minimal spanning tree	1
	Properties of trees	1
	Algorithms: Dijkstra's Algorithm for shortest path problem	1
	Determination of minimal spanning tree using DFS, BFS	2
	Kruskal's and Prim's algorithms	1
5	Improper Integral & Laplace Transform	14L
	Basic ideas of improper integrals	1
	Working knowledge of Beta and Gamma functions (convergence to be assumed) and their interrelations	2
	Laplace Transform (LT): Definition and existence of LT	2
	LT of elementary functions	1
	First and second shifting properties, Change of scale property	1

	LT of different forms	2
	Evaluation of improper integrals using LT	1
	LT of periodic and step functions	1
	Inverse LT: Definition and its properties	1
	Convolution Theorem and its application to the evaluation of inverse LT	1
	Solution of linear ODE with constant coefficients using LT	2

Assignment:

Module-1:

Solve the following equations:

- $(x^4 - 2xy^2 + y^4)dx = (2x^2y - 4xy^3 + 5y^5)dy$.
- $y^2 - 2x^2 - (1 + y^2 + c_1^2 x)dy = 0$.
- $ye^x dx + (xe^x + 2y)dy = 0$.
- $(s + e^{2x})dx + (c_1 + t_1)dy = 0$.
- $y(1 + x)dx + x(1 - x)dy = 0$.
- $(xy^2 + 2x^2y^3)dx + (x^2y - x^3y^2)dy = 0$.
- $(y^2e^{xy^2} + 4x^3)dx + (2xe^{xy^2} - 3y^2)dy = 0$.
- $y(y^2 - 2x^2)dx + x(2y^2 - x^2)dy = 0$.
- $x^3y^3(2y + x) - (5y^4 + 7x^4) = 0$.
- $(5x^2 + x - 1)dx + \left(\frac{1}{x}x^2 - y + 2y^2\right)dy = 0$; given $y = 1$ when $x = 0$.
- $\frac{dy}{dx} = \frac{y-2x}{2y-x}, y(1) = 2$.
- Prove that e^{x^2} is an I.F. of the equation $(x^2 + xy^4)dx + 2y^3dy = 0$ And hence solve it.
- Show that $\frac{1}{3x^2y^2}$ is an I.F. of $y(x^2 + 2x^2y^2)dx + x(x^2 - x^2y^2)dy$.
- Find IF for $(x^4 + y^4)dx - xy^3dy = 0$
- Find IF for $(y^4 + 2y)dx + (xy^3 + 2y^4 - 4x)dy = 0$

Module-2:

Solve (1 – 24) –

- $(D^2 + D - 2)y = e^x$
- $(D^2 - 3D + 2)y = \frac{e^{3x} + e^x}{x}$
- $(D^2 + 4)y = 8 \cos 2x$
- $(D^2 + 9)y = \cos 2x + \sin 2x$
- $(D^2 + 2D + 10)y + 37 \sin 2x = 0$
- $(D^2 + 1)y = \sin x \sin 2x$
- $(D^2 - 4D + 4)y = x^2$

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8. $(D^2 - 4)y = x^4 + 3x^2 + x + 1$
9. $(D^2 + 2D + 1)y = e^x + x^3 + 3x$
10. $(D^2 - 2D + 1)y = e^x x^2$
11. $(D^2 + 4D - 12)y = e^{2x} (x - 1)$
12. $(D^2 - 5D + 6)y = e^{4x} (x^2 + 9)$
13. $(D^2 + 4)y = \tan 2x$
14. $(D^2 + a^2)y = \cos ax$
15. $(D^2 + n^2)y = \cot nx$
16. $(x^2 D^2 - 3xD + 5)y = x^2 \sin x$
17. $(x^2 D^2 + 7xD + 13)y = \log x$
18. $(x^2 D^2 + xD - 1)y = x^8$
19. $(x^2 D^2 - 4xD + 6)y = x^4$
20. $(x^2 D^2 + xD - 1)y = 4$
21. $(x^2 D^2 + 2xD - 20)y = (x + 1)^2$
22. $(x^2 D^2 - xD + 3)y = x^2 \log x$
23. $(x^2 D^2 - 2xD + 2)y = \frac{1}{x}$
24. $(x^2 D^2 + 4xD + 2)y = x + \sin x$

Solve using Variation of Parameter Method (25 – 32) –

25. $(D^2 + a^2)y = \cos ax$
26. $(D^2 - 2D + 1)y = xe^x$
27. $(D^2 + 2D + 1)y = 2x$
28. $(D^2 - 3D + 2)y = -1$
29. $(D^2 - 3D + 2)y = \frac{e^x}{e^x + 1}$
30. $(D + 2)y = 4e^{2x}$
31. $(D - 2x)y = -2x$
32. $(D^2 + 2D + 1)y = x^2 e^3$

Solve simultaneous Linear Differential Equations (32 – 40) –

33. $Dx + 2x - 3y = t; Dy - 3x + 2y = e^{2t}$
34. $Dx = a + b; Dy = c + d$
35. $Dx + 2Dy - 2x + 2y = 3e^t; 3Dx + Dy + 2x + y = 4e^{2t}$
36. $Dx + Dy - 2y = 2 \cos t - 7 \sin t; Dy - Dx + 2x = 4 \cos t - 3 \sin t$
37. $D^2 x + 4x + y = te^{3t}; D^2 y - 2x + y = \cos t$
38. $4Dx + 9Dy + 44x + 49y = t; 3Dx + 7Dy + 34x + 38y = e^t$
39. $(D + 1)x + (D - 1)y = e^t; (D^2 + D + 1)x + (D^2 - D + 1)y = t^2$
40. $(5D + 4)x - (2D + 1)y = e^{-t}; (D + 8)x - 3y = 5e^{-t}$

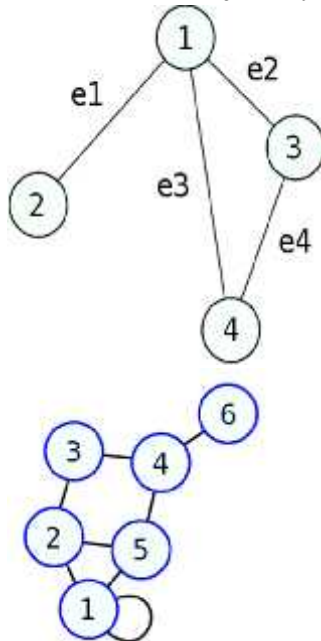
Module-3:

1. Draw a graph with 9 vertices having degree 1,5,2,7,10,8.
2. Determine the number of edges with 6 nodes, two of degree four and 4 of degree 2.
3. Find the maximum number of vertices in a connected graph having 17 edges.

4. Construct the graph corresponding to the following adjacency matrix:

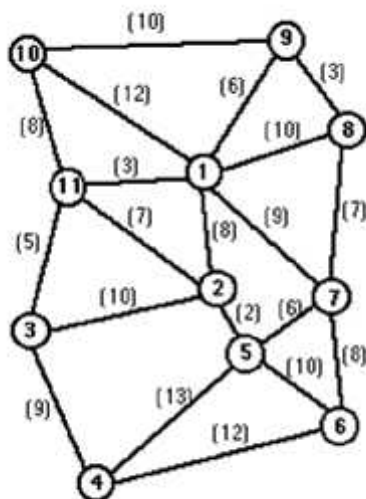
$$\begin{bmatrix} 1 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 \\ 1 & 1 & 1 & 0 \end{bmatrix}$$

5. Write down the adjacency matrix of the following graphs:



Module-4:

1. Find by kruskal's Algorithm and prim's algorithm a minimal spanning tree of the following graph:



2. Show that the number of vertices of a binary tree can't be even.
3. Show that every connected graph has a spanning tree.
4. Show that every edge of a connected graph is a branch of some spanning tree of G.
5. Prove that the number of cut vertices in a binary tree is always even.

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6. Construct a graph having edge connectivity 4, vertex connectivity 3 and degree of each vertex ≥ 5 .

Module-5:

1. Write the conditions for Existence of LT.
2. Find the value of $\Gamma(1/2)$.
3. Evaluate: $\int_0^{f/2} \sqrt{\tan x} dx$.
4. Evaluate $\int_0^{\infty} \sqrt{x} e^{-x^2} dx$.
5. Evaluate the integration using Laplace Transform $\int_0^{\infty} x e^{-2x} \cos x dx$
6. Find the Laplace Transform of the unit step function.
7. Apply Convolution Theorem to find $L^{-1} \left[\frac{s}{(s^2 + 9)^2} \right]$.
8. $\int_0^{\infty} e^{-3x} \sin x \cos x dx$, find the value of integration with the help of LT.
9. $f(x) = \begin{cases} 3-x & 2 < x < 3 \\ x-1 & 1 < x < 2 \end{cases}$, find LT
10. $f(x) = \begin{cases} 2c-x & c < x < 2c \\ x & 0 < x < c \end{cases}$, where $f(x)$ is a periodic function of period $2c$.
11. $f(x) = \begin{cases} 0 & 1 \leq x \leq 2 \\ t & 0 \leq x \leq 1 \end{cases}$, where $f(x)$ is a periodic function of period 2.
12. $f(x) = \begin{cases} 1 & x > f \\ 2x & 0 < x < f \end{cases}$, find LT
13. $\int_0^{\infty} \frac{1 - \cos x}{x^2} dx$, find the value of integration with the help of LT.
14. $\int_0^{\infty} x e^{-2x} \cos x dx$, find the value of integration with the help of LT.
15. $f(x) = \begin{cases} 6 & 2 < x < 4 \\ 3x & 0 < x < 2 \end{cases}$, where $f(x)$ is a periodic function of period 4.
16. $f(x) = \begin{cases} 5 \sin 3 \left(x - \frac{f}{4} \right) & x > f/4 \\ 0 & x < f/4 \end{cases}$, find LT
17. $x \int_0^x \frac{\sin u}{u} du$, find LT
18. $\int_0^x u e^{-3u} \cos 4u du$, find LT

19. $\int_0^x \frac{e^{2u} \sin u}{u} du$, find LT
20. $\sin 3x \sin 2x$, find LT
21. $\int_0^\infty x \cos 2x dx$, find the value of integration with the help of LT.
22. $f(x) = \begin{cases} 0 & 2 < x < \infty \\ x & 0 < x < 2 \end{cases}$, find LT
23. $f(x) = \begin{cases} -1 & f < x < 2f \\ 1 & 0 < x < f \end{cases}$, find LT
24. Given $f(x) = \begin{cases} 5 & x > 4 \\ x & 0 < x < 4 \end{cases}$, then find $L\left[\frac{d}{dx} f(x)\right]$.
25. Prove $L^{-1}\left[\frac{s}{(s^2 - a^2)^2}\right] = \frac{x \sin ax}{2a}$, with the help of Convolution Theorem.
26. Apply Convolution Theorem to find $L^{-1}\left[\frac{s}{(s^2 + 9)^2}; x\right]$
27. Apply Convolution Theorem to find $L^{-1}\left[\frac{1}{(s^2 + 2s + 5)^2}; x\right]$
28. Apply Convolution Theorem to find $L^{-1}\left[\frac{1}{(s-2)(s^2 + 1)}; x\right]$
29. Verify convolution theorem for $F(s) = \frac{s}{(s^2 + 1)^2}$.
30. Show that $1 * 1 * 1 \dots * 1 (n \text{ times}) = \frac{x^{n-1}}{(n-1)!}$, where n is any positive integer.
31. $L\left[\int_0^x \frac{1 - e^{-u}}{u} du; s\right]$
32. $L\left[\cosh x \int_0^x e^u \cosh u du; s\right]$
33. $L[2 \cos 2x - 3 \sin 4x + 6x^3 + 4e^{5x}; s]$
34. $f(x) = \begin{cases} (x-2)^2 & x > 1 \\ 0 & 0 < x < 1 \end{cases}$, find LT
35. Prove that $L^{-1}[sF''(s)] = x^2 f'(x) + 2xf(x)$ where $f(x) = L^{-1}[F(s); x]$.
36. $L^{-1}\left[\frac{s}{(s^2 - k^2)^2}; x\right]$ if $L^{-1}\left[\frac{1}{s^2 - k^2}; x\right] = \frac{\sinh kx}{x}$.
37. $L^{-1}\left[\frac{8e^{-3s}}{s^2 + 4}; x\right]$
38. $L^{-1}\left[\frac{(s+1)e^{-fs}}{s^2 + s + 1}\right]$

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Lecture-wise Plan

Subject Name: Basic Electrical & Electronics Engineering-II
Year: 1stYear

Subject code: ES201
Semester: Second

Module Number	Topics	Number of Lectures
1.	Field Effect Transistors:	5L
	1. Concept of Field Effect Transistors (channel width modulation)	1
	2. Gate isolation types, JFET Structure and characteristics	1
	3. MOSFET Structure and characteristics	1
	4. depletion and enhancement type; CS, CG, CD configurations	1
	5. CMOS: Basic Principles	1
2.	Feed Back Amplifier, Oscillators and Operational Amplifiers::	10L
	1. Concept (Block diagram), properties, positive and negative feedback,	1
	2. loop gain, open loop gain, feedback factors; topologies of feedback amplifier; effect of feedback on gain, output impedance, input impedance, sensitivities (qualitative), bandwidth stability; effect of positive feed back	3
	3. Instability and oscillation, condition of oscillation, Barkhausen criteria.	1
	4. Introduction to integrated circuits, operational amplified and its terminal properties.	1
	5. Application of operational amplifier; inverting and non-inverting mode of operation, Adders, Subtractors	2
	6. Constant-gain multiplier, Voltage follower, Comparator, Integrator, Differentiator	2
3.	Digital Electronics:	5L
	1. Introduction to binary number	2
	2. Basic Boolean algebra	2
	3. Logic gates and function realization with OPAMPs	1
Total Number Of Hours = 20		

Signature of Faculty

Signature of HOD

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Lecture-wise Plan

Assignment:

Module-1:

1. Draw a neat sketch to illustrate the structure of a N-channel E-MOSFET. Explain its operation.
2. What do you mean by trans conductance?
3. Derive the expression of transconductance.
4. Explain why FET is a voltage controlled device.

Module-2:

1. Draw different topologies of feedback amplifier.
2. Mention the ideal characteristics of feedback amplifier.
3. Derive the feedback gain of voltage series feedback amplifier.
4. An amplifier, without feedback, has a voltage gain of 400, lower cut-off frequency $f_1 = 50$ Hz, upper cutoff frequency $f_2 = 200$ KHz and a distortion of 10%. Determine the amplifier voltage gain, lower cut-off frequency and upper cut-off frequency and distortion, when a negative feedback is applied with feedback ratio of 0.01.
5. State and prove Barkhausen criteria.
6. Draw and derive the output voltage of inverting amplifier.
7. Design a subtractor circuit using single opamp.

Module-3:

1. Prove that

$$(a) \quad BCD + A \bar{C} \bar{D} + ABD = ABD + A \bar{C} \bar{D} + AB \bar{C}$$

$$(b) \quad (A + B)(\bar{A} \bar{C} + C)(\bar{B} + AC) = \bar{A} B$$

2. Design a XOR gate using NAND gate only.

Subject Name: Basic Electrical Engineering-II

Year: 1st Year

Subject Code-ES201

Semester: Second

Module Number	Topics	Number of Lectures
1	Electrostatics	3L
	1. Coulomb's law, Electric Field Intensity, Electric field due to a group of charges, continuous charge distribution, Electric flux, Flux density, Electric potential, potential difference	1
	2. Gauss's law, proof of gauss's law, its applications to electric field and potential calculation	1
	3. Capacitor, capacitance of parallel plate capacitor, spherical capacitor, isolated spheres, concentric conductors, parallel conductors. Energy stored in a capacitor.	1
	Single phase transformer:	6L

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2	1. Core and shell type construction, Working Principle EMF equation	2
	2. No load and on load operation, phasor diagram and equivalent circuit,	2
	3. Losses of a transformer, open and short circuit tests, regulation and efficiency calculation.	2
	DC Machines:	8L
3	1. Construction, Basic concepts of winding (Lap and wave)	2
	2. DC generator: Principle of operation, EMF equation, characteristics (open circuit, load)	2
	3. DC motors: Principle of operation, Speedtorque Characteristics (shunt and series machine)	2
	4. Starting (by 3 point starter), speed control (armature voltage and field control)	2
	Three phase system:	2L
4	1. Voltages of three balanced phase system, delta and star connection, relationship between line and phase quantities, phasor diagrams	2
	1. synchronization hardware, classical problems of synchronization, semaphores.	2
Total Number Of Hours = 19		

Assignment:

Module-1(Introduction):

1. A Charge $8 \times 10^{-8} \text{C}$ is distributed uniformly on the surface of a sphere of radius 1cm. It is covered by a Concentric, hollow conducting sphere of radius 5cm.
 - (a) Find the electric field at a point 2 cm away from the centre.
 - (b) A charge $6 \times 10^{-8} \text{C}$ is placed on the hollow sphere. Find surface charge density on the outer surface of the hollow sphere.

Module-2 (Single Phase Transformer):

1. A 200/50 v, 50 Hz transformer has a core area of 100 cm^2 . The maximum value of the flux density is 1 wb/m^2 . Assuming 9% loss of area due to the laminations, find the primary and secondary number of turns and transformation ratio.
2. A 40 KVA, 2500/500 V single-phase transformer has the following parameters. $R_1=8 \text{ ohm}$, $R_2= 0.5 \text{ ohm}$, $X_1=20 \text{ ohm}$, $X_2=0.8 \text{ ohm}$. Find the voltage regulation and the

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Lecture-wise Plan

secondary terminal voltage at full load for a p.f of 0.8 lagging. The primary voltage is held constant at 2500 V.

3. A Single-Phase transformer supplies a load of 20 KVA at a p.f of 0.81(lagging). The iron loss of the transformer is 200 W and copper losses at this load is 180 W. Calculate (i) the efficiency, (ii) if the load is now changed to 30 KVA at a p.f of 0.91(lagging) calculate the new efficiency.

Module-3(DC Machines):

1. A Dc shunt generator has an induced voltage of 220V on open circuit. When the machine is on load the voltage is 200 V. Find the load current if the field resistance is 100 ohm and armature resistance is 0.2 ohm
2. A 240 V shunt motor has an armature resistance of 0.2 ohm and takes armature current of 20 A on full load. The electromagnetic torque being constant, by how much the flux be reduced to increase the speed by 40%.
3. A 400 V, 6-Pole Shunt motor has a two circuit armature winding with 250 conductors. The armature Resistance is 0.3 ohm, field resistance 200 ohm and flux/pole is 0.04 wb. Find the speed and electromagnetic torque developed if the motor draws 10 A from the supply.

Module-4(Three Phase system):

1. Derive the relationship between the phase and line voltage of star and delta connection respectively. Also find the relationship for the line and phase current for star and delta connection.
2. The load in each branch of a star connected three-phase circuit consists of 10 ohm resistance and 0.06H inductance in series. The line voltage is 430 V. Calculate the phase voltage and phase current.
3. Three similar coils each having series resistance of 20 ohm and capacitance $100\mu\text{F}$ are connected in star to a 3-phase, 400 V, 50Hz balanced supply. Find the line current, power factor, total KVA and total KW.

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Subject Name: Engineering Thermodynamics & Fluid Mechanics
Year: 1st Year

Subject Code-ME201
Semester: Second

Modules

Lectures

Module 1

Basic Concepts of Thermodynamics

7 lectures

Introduction: Basic terminologies

2 lectures

Zeroth law of thermodynamics

1 lecture

Calculation of work done

1 lecture

Numerical Problems

3 lectures

Module 2

1st Law of Thermodynamics

7 lectures

First law of thermodynamics

1 lecture

Steady flow energy equation

1 lecture

Mass balance

1 lecture

Numerical Problems

4 lectures

Module 3

2nd Law of Thermodynamics

9 lectures

Second law of thermodynamics

1 lecture

Carnot Cycle, Carnot Engine

2 lectures

Heat Engine, Heat Pump and Refrigerator

1 lecture

Entropy and PMM-2

1 lecture

Numerical Problems

4 lectures

Module 4

Air standard Cycles for IC engines

8 lectures

Air Standard Cycles, Otto Cycles

2 lectures

Rankine cycle, Diesel Cycles

1 lecture

Petrol Engine and Diesel Engine

1 lecture

Numerical Problems

4 lectures

Module 5

Properties & Classification of Fluids

8 lectures

Fluid Static and Fluid Dynamics

1 lecture

Types of Fluids and continuity equation

1 lecture

Euler's Equation and Bernoulli's Equation

1 lecture

Practical application of Bernoulli's equation

1 lecture

Numerical Problems

4 lectures

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Lecture-wise Plan

Subject Name: Engineering Thermodynamics & Fluid Mechanics

Subject Code-ME201

Year: 1st Year

Semester: Second

Syllabus for ETFM is planned to be over in maximum of 39 lectures for 1st year/II semester.

	Assignment No. 1
Q1	Define Thermodynamics and Thermodynamic system?
Q2	Differentiate between various types of thermodynamic system and give examples of each of them?
Q3	Define Quasi Static Process also explain macroscopic and microscopic points of view?
Q4	What do you mean by thermodynamic property, explain with examples?
Q6	What is energy? Explain different form of energy?
Q7	What do you mean by path function and point function? Give examples also?
Q8	Calculate the work done in a piston cylinder arrangement during the expansion process, where the process is given by the equation ($P=V^2+6V$) bar. The volume changes from 1 m ³ to 4 m ³ during the expansion. (Ans : 66X10 ⁵ J)
Q9	Explain the term state, path, process and cycle?
Q10	Give your views about First Law of Thermodynamics?
	Assignment No. 2
Q11	Explain the statements of Second Law of Thermodynamics with the help of Heat engine, Heat Pump and Refrigerator?
Q12	Define efficiency of heat engine, COP of refrigerator and COP of heat pump?
Q13	A undergoes a cycle composed of four processes. The heat transfers in each process are 450KJ, -265 KJ, -250KJ and 300KJ. The respective work transfers are 300KJ, 0, -65KJ and 0. Is the data consistent with first law of thermodynamics.
Q14	The working substance in an engine executes a cyclic process, and two work transfers are involved 15KJ to the working substance and 25KJ from the working substance. The working substance three heat transfers, two of which are 70KJ to the working substance and 45 KJ from the working substance. Determine the third heat interaction?
Q15	Explain “ Entropy – a property of a system”?
Q16	A Carnot heat engine operates between source and sink temperature of 300°C and -5°C. If the system receives 95KJ/S from the source, Find (i) Efficiency of the engine (ii) The net work output (iii) Heat rejected to the sink.
Q17	Show the various parts of IC Engine with a neat diagram?
Q18	Define : (i)Bore (ii) Stroke (iii) Clearance Volume (iv)Compression Ratio(v) Dead Centre (vi) Connecting Rod
	Assignment No. 3
Q19	Explain (a) Density – Mass and Weight (b) Specific Weight (c) Specific Gravity
Q20	A plate having a velocity 100cm/s moves 0.05mm apart from a fixed plate. Determine viscosity of the fluid if force required to move the upper plate is 5 N/m ² .
Q21	Give (a) Reynolds Equation (b) Stokes Equation (c) Euler’s Equation related from Fluid Dynamics?
Q22	A incompressible fluid is flowing through a pipe of 10 cm diameter under a gauge pressure of 40 N/cm ² and with a mean velocity of 5.0 m/s. Find the total head of the water at a cross section, which is 8m above the datum line?
Q23	What do you mean by continuity equation?
Q24	The diameter of a pipe at the section 1 and 2 are 15cm and 25cm respectively. Find the discharge through the pipe if the velocity of water flowing through the pipe at section 1 is 6m/s. Determine also the velocity at section 2.
Q25	Define Enthalpy?
Q26	Derive expressions of work done for isothermal. Isentropic, isobaric and polytropic processes? Give neat PV diagrams of all processes?

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Lecture-wise Plan

Subject Name: Engineering Thermodynamics & Fluid Mechanics

Subject Code-ME201

Year: 1st Year

Semester: Second

Q27	A gas undergoes a reversible non flow process according to the relation $P = (-3V+15)$ where V is the volume in m^3 and P is the pressure in bar. Determine the work done when the volume changes from 3 to 6 m^3 .																				
Q28	During the execution of a reversible non flow process the work done is 155.4 kJ. If $V_1 = 0.85 m^3$ and pressure during the process varies as $P = (-3V+7)$ bar, where V is in m^3 . Find the final volume.																				
Q29	A fluid system undergoes a frictionless process from $V_1 = 0.1281 m^3$ to $V_2 = 0.0427 m^3$ following the relation $P = (\frac{4.2}{V} + 2.1)$ bar. Where V is in m^3 . Find the work done during the process.																				
	Assignment No. 4																				
Q30	A mass of gas is compressed in quasi static process from 80 kpa, 0.1 m^3 to 0.4 MPa, 0.03 m^3 . Assume that the pressure and volume are related by $PV^n = \text{constant}$, find the work done by the gas system.																				
Q31	Discuss the concept of continuum and its relevance. Distinguish between reversible and irreversible processes?																				
Q32	A closed vessel contains 1 kg of Nitrogen at 20° C temperature and 0.981 bar abs pressure. Heat is supplied to the vessel till the gas acquires a pressure of 1.962 bar abs. Find out (a) final temperature of the gas (2) work done (3) heat added (4) change in internal energy. Take $C_v = 0.745 \text{ kJ/kg-K}$																				
Q33	A mass of 0.05 kg of a fluid is heated at constant pressure of 1.962 bar until the volume occupied is 0.658 m^3 . Calculate the heat supplied and the work done. Assume working fluid is perfect gas at an initial temperature of 130°C. Assume C_p for air = 1.00 kJ/kg-K and $R = 0.289 \text{ kJ/kg-K}$																				
Q34	1 Kg of nitrogen is compressed reversibly and isothermally from 1.177 bar pressure and 20°C temperature to 4.218 bar pressure. Calculate the work done and heat flow during the process. Assume nitrogen to be a prefect gas. $R = 0.297 \text{ kJ/kg-K}$																				
Q35	Air at 0.981 bar pressure and 22°C initial temperature occupying a cylinder volume of 0.015 m^3 , is compressed reversibly and adiabatically by a piston to a pressure of 6.867 bar. Calculate the final temperature, the volume and the work done on the air in the cylinder. Assume $\gamma = 1.4$. $C_v = 0.171$, $R = 0.289 \text{ KJ/kg-K}$																				
Q36	2 Kg of air at a pressure of 6.867 bar occupies a volume of 0.28 m^3 ; this air is then expanded to a volume of 1.4 m^3 by law $p v^{1.2} = \text{constant}$. Assume $R = 0.287 \text{ kJ/kg-K}$, $C_p = 0.238 \text{ kJ/kg-K}$, $C_v = 0.707 \text{ kJ/kg-K}$ and $\gamma = 1.4$. Find (a) the final temperature (b) the work done (c) heat absorbed or rejected?																				
Q37	<div>A system undergoes a cyclic composed of four processes 1-2,2-3,3-4,4-1. The energy transfers are tabulated below:</div> <table><tr><td>Process</td><td>Q (kJ/min)</td><td>W(kn-m/min)</td><td>ΔU (kJ/min)</td></tr><tr><td>1-2</td><td>400</td><td>150</td><td>-----</td></tr><tr><td>2-3</td><td>200</td><td>-----</td><td>300</td></tr><tr><td>3-4</td><td>-200</td><td>-----</td><td>-----</td></tr><tr><td>4-1</td><td>0</td><td>75</td><td>-----</td></tr></table> <div>(a) Complete the table and (b) Determine the rate of work in KW</div>	Process	Q (kJ/min)	W(kn-m/min)	ΔU (kJ/min)	1-2	400	150	-----	2-3	200	-----	300	3-4	-200	-----	-----	4-1	0	75	-----
Process	Q (kJ/min)	W(kn-m/min)	ΔU (kJ/min)																		
1-2	400	150	-----																		
2-3	200	-----	300																		
3-4	-200	-----	-----																		
4-1	0	75	-----																		
Q38	A steam turbine operating under steady flow conditions, receives 3600 kg of steam per hour. The steam enters the turbine at a velocity of 80 m/s, an elevation of 10 m and specific enthalpy of 3276kJ/kg. It leaves the turbine at a velocity of 150 m/s, an elevation of 3m and a specific enthalpy of 2465 kJ/kg. Heat losses from the turbine to the surroundings amount to 36 MJ/hour. Estimate the power output of the turbine.																				
Q39	Steam enters into a steam turbine with a velocity of 30m/s and enthalpy of 2610 kJ/kg and leaves with a velocity of 10m/s and enthalpy of 2050 KJ/kg. Heat lost to the surrounding																				

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Subject Name: Engineering Thermodynamics & Fluid Mechanics

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Year: 1st Year

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	due to temperature difference is 280kj/min and steam consumption rate of the turbine is 6000kg/hr. Calculate the power developed by the steam turbine.
	Assignment No. 5
Q40	A reversible heat engine operates between reservoirs at 420 K and 280 K. If the output from the engine is 2.5 KJ, Determine the efficiency of the engine and its heat interactions with the two heat reservoirs. Subsequently the engine is reversed and made to operate as heat pump between the same reservoirs. Calculate the coefficient of performance of the heat pump and power input required when the heat transfer rate from the 280 K reservoir is 5kW.
Q41	An inventor claims to have developed an engine that takes in 110MJ at a temperature of 227°C, rejects 43MJ at a temperature of 27°C and delivers 16kWh of work. Would you advise investing money to put this engine in the market?
Q42	A cold storage is to be maintained at -2°C, while the surroundings temperature is 39°C. The heat leakage from the surroundings into the cold storage is estimated to be 31kW. The actual COP of the refrigeration plant is 30% of the ideal plant working between the same temperatures. Find the power required to drive the plant.
Q43	Differentiate between 4Stroke and 2 Stroke Engine
Q44	Differentiate between SI and CI Engine
Q45	An engine working on a Diesel cycle has a compression ratio of 20 and cut off ratio takes place at 5% of the stroke. Find the air standard cycle efficiency. Assume $\gamma = 1.4$.
Q46	The oil (viscosity = 1 Ns/m ²) used for lubricating the clearance of 1mm between a shaft of diameter 15cm and its journal bearing. If shaft rotates at 200 rpm, find the shear stress required?
Q47	A pipe having diameters 200mm and 400mm at sections 1 and 2 respectively is carrying a fluid of specific gravity 0.87 and the difference in datum head is 4m. The pressure at the sections 1 and 2 are 9.81 N/cm ² and 4.2 N/cm ² respectively. Determine the loss of head and direction of flow when rate of flow through pipe is 200 liters/s?

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Lecture-wise Plan

Subject Name: English Language & Technical Communication-II **Subject Code-HU201**
Year: 1st Year **Semester: Second**

Module Number	Topics	Number of Lectures
1	ENGLISH LANGUAGE GRAMMAR	10L
	1. Subject verb agreement,	3
	2. Tense, voice, improvement of sentences, rearrangement of sentences.	4
	Vocabulary: usage, synonyms, antonyms.	3
2	WRITING COMPREHENSION	10L
	1. Forms of Writing: The Essay, The Précis, The Report.	5
	2. The Proposal, The C.V. and Job Application letter. The Presentation.	5
3.	TECHNICAL COMMUNICATION	6L
	1. Role Playing, Group Discussion.	6
Total Number Of Hours = 26		

Faculty In-Charge

HOD, HU Dept.

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Lab Manual

Title of Course: Principles of Computer Programming-II Lab

Course Code: CS 291

L-T-P Scheme: 0-0-3

Course Credit: 2

Objectives:

The course presents basics of C++ programming including: Basics of C++ environment, Data representation, Control structures, Functions, Arrays, Pointers, Strings, and Classes that aims to:

-) Understand object oriented programming and able to explain the difference between object oriented programming and procedural programming.
-) Be able to program using more advanced C++ features such as composition of objects, operator overloads, dynamic memory allocation, inheritance and polymorphism, file I/O, exception handling, etc.
-) Be able to build C++ classes using appropriate encapsulation and design principles.

Learning Outcome:

-) Be able to develop, design and implement simple computer programs.
-) Understand functions and parameter passing.
-) Be able to do numeric (algebraic) and string-based computation.
-) Understand object-oriented design and programming.
-) Understand dynamic memory allocation and pointers.
-) Be able to design, implement, and test relatively large C++ programs.

Lab Content:

Exercises that must be done in this course are listed below:

Experiment1:-Write a C++ programme to take 10 integer data from the user and find out the maximum minimum from that data.

Experiment 2:-Write a c++ program to generate the Fibonacci series by using class.

Experiment 3:-Write a program to calculate $1+x+x*x+x*x*x.....$ using loop.

Experiment 4:-Write a program in c++ to find the reverse of a number.

Experiment 5:-A shop required to store information about each item. Information will be item code, price and available quantities. User (sales person) will store information about each item and can display information about each item. Model the above problem with OOP.

Experiment6:-A cricket organization need to store information like name, number of innings, number of not out innings, total run scored and total wicket taken of each cricketer. After storing data, organization will analyze the data and want to come on the following conclusion: If a cricketer plays more or equal inning and is batting average is more than 35 then recognize him as a "BATSMAN". if a cricketer plays more or equal to 50 innings' and if taken more than 49 wickets then recognize him as a "BOWLER".if one satisfies both condition then he will be "ALL ROUNDER". Organization needs to display each information about each cricketer. Model above problem using OOPs.

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Experiment 7:-Create a class with two private integer data member, initialize them with constructor. Now display data members with the help of function which is not a member of that class.

Experiment 8:-Write a C++ program to display the concept of function with default argument.

Experiment 9:-Create class 'fun' with one private float data member. initialize that data member with constructor. similarly create another class magic with private data member. Initialize that data member with constructor. now using friend function check data member of which class is greater.

Experiment 10:-Create a class test with one private float data member initialize that data member with constructor similarly create another class testing with one private data member. Initialize that data member with constructor. Now using function swap the value of data member of the classes.

Experiment 11:-Write a C++ program to demonstrate the concept of single inheritance.

Experiment 12:-Write a C++ program to demonstrate the concept of multiple inheritance.

Experiment 13:-Write a C++ program to demonstrate the concept of MULTILEVEL inheritance.

Experiment 14:-Write a C++ program to demonstrate the concept of HYBRID inheritance.

Experiment 15:-An application needs to swap two integer and two float values using functions. Approach the above problem using functions with same name.

Experiment 16:-Write a program to calculate the number of objects created by your program.

Experiment 17:-Write a C++ program to achieve the following thing. A class contains 3 data member of type integer. Use ++ and -- operator in a way so that whenever we use ++ with the object of, all data member will incremented by one. Similarly, -- will work.

Experiment 18:-Write a program to add two complex number using operators overloading.

Experiment 19:-Write a C++ program to demonstrate the concept of Virtual Class.

Experiment 20:-Write a C++ program to show how Run Time Polymorphism is achieved in C++.

Text Books:

-) Schildt, H., The Complete Reference C++, Tata McGraw Hill Education Pvt. Ltd.
-) E.Balagurusamy; Object Oriented programming with C++; Tata McGraw Hill Education Pvt. Ltd.

Reference Books:

-) Debasish Jana, C++ object oriented programming paradigm, PHI.
-) D. Ravichandran, Programming with C++, Tata McGraw Hill Education Pvt. Ltd.
-) Y.I. Shah and M.H. Thaker, Programming In C++, ISTE/EXCEL BOOKS.

Recommended Systems/Software Requirements:

1. Intel based desktop PC with minimum of 166 MHZ or faster processor with at least 64 MB RAM and 100 MB free disk space.
2. Turbo C++ compiler in Windows XP/7 or Linux Operating System.

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Experiment1:-Write a C++ programme to take 10 integer data from the user and find out the maximum minimum from that data.

Function declares two integers **max** and **min** and assign both integers with **arrays** first index value. Then with in for loop there are two if condition first check is for **minimum** number and second check is for **maximum** number. Finally program display the output values of both integers **min** and **max**.

```
#include<iostream.h>

#include<conio.h>

int main()

{

clrscr();

int a[6],i,large,small;

cout<<"Enter the value=";

for(i=0;i<6;i++)

{

cin>>a[i];

}

large=a[0];

for(i=0;i<6;i++)

{

if(a[i]>large)

{

large=a[i];

}

}

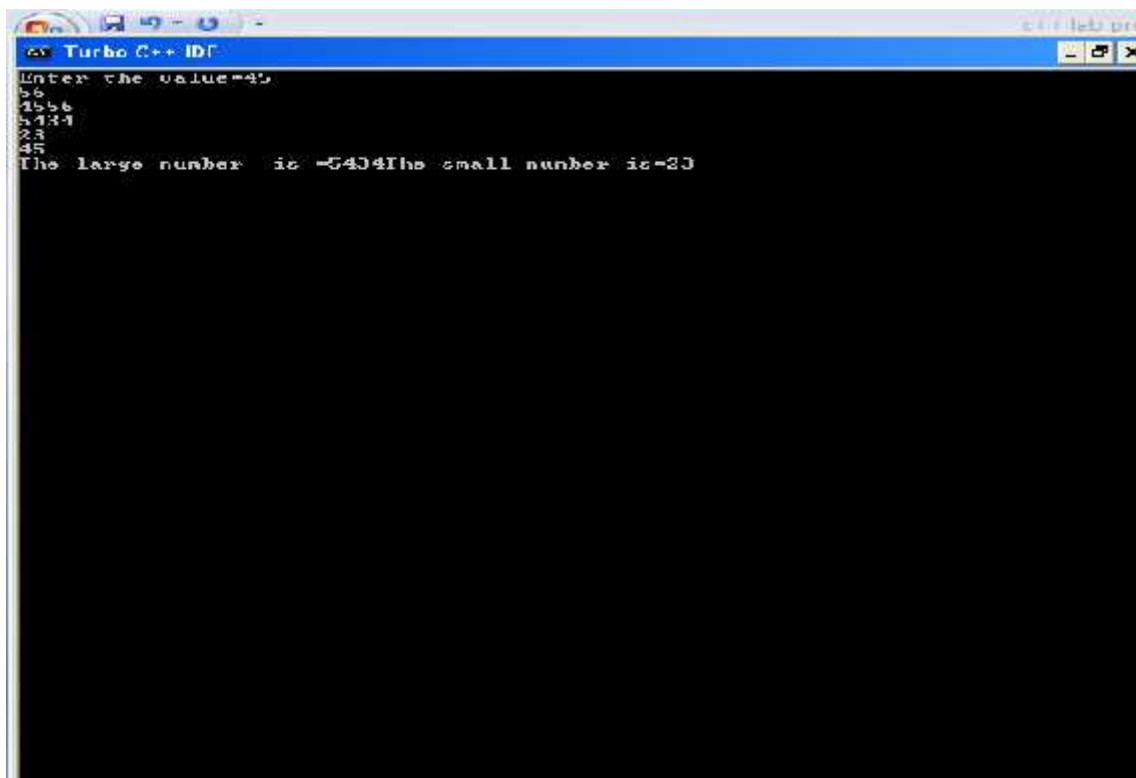
cout<<"The large number is "<<large;

small=a[0];

for(i=0;i<6;i++)
```

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```
{  
if(a[i]<small)  
{  
small=a[i];  
}  
}  
  
cout<<"The small number is"<<small;  
  
getch();  
  
return 0;  
}
```



The screenshot shows the Turbo C++ IDE window titled 'Turbo C++ IDE'. The console output is as follows:

```
Enter the value=45  
56  
1556  
-134  
23  
45  
The large number is -5434The small number is-23
```

Experiment 2.write a c++ program to generate the Fibonacci series by using class.

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In mathematics, the Fibonacci numbers or Fibonacci series or Fibonacci sequence are the numbers in the following integer sequence:

1 1 2 3 5 8 13 21 34 55 89 144

By definition, the first two numbers in the Fibonacci sequence are 0 and 1, and each subsequent number is the sum of the previous two.

```
#include<iostream.h>
```

```
#include<conio.h>
```

```
classfibonacii
```

```
{
```

```
inti,a,b,s,fibo,n;
```

```
public:
```

```
voidgetdata();
```

```
void display();
```

```
};
```

```
voidfibonacii::getdata()
```

```
{
```

```
a=0;
```

```
b=1;
```

```
cout<<"Enter the value n:";
```

```
cin>>n;
```

```
s=0;
```

```
for(i=0;i<n-1;i++)
```

```
{
```

```
fibo=a+b;
```

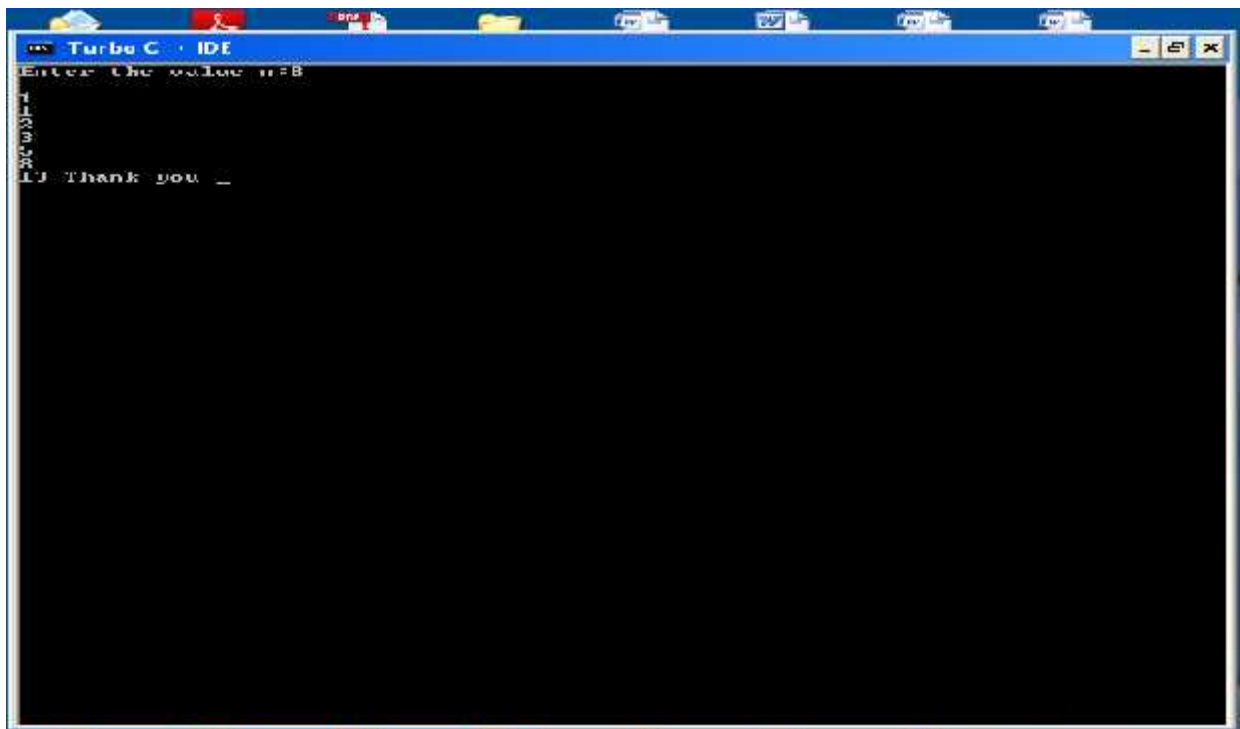
```
cout<<"\n"<<fibo<<" ";
```

```
b=a;
```

```
a=fibo;
```

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```
}  
  
}  
  
void fibonacii::display()  
{  
    cout<<"Thank you " ;  
}  
  
int main()  
{  
    clrscr();  
    fibonacii f;  
    f.getdata();  
    f.display();  
    getch();  
    return 0;  
}
```



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Experiment 3.write a program to calculate $1+x+x^2+x^3+x^4+x^5$using loop.

Here's a C++ program to calculate the series with output. This program makes use of C++ concepts like for loop,The program also uses C++'s math.h header file and power function **pow(i, j)**.

```
#include<iostream>
```

```
#include <math.h>
```

```
Using namespace std;
```

```
class series
```

```
{
```

```
inta,b;
```

```
public:
```

```
voidgetdata();
```

```
void cal();
```

```
void display();
```

```
};
```

```
Void series::getdata()
```

```
{
```

```
Cout<<"Enter the value of a:"
```

```
Cin>>a;
```

```
}
```

```
Void series::cal()
```

```
{
```

```
intc,i;
```

```
c=1;
```

```
cout<<"Enter the limit:";
```

```
cin>>b;
```

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```
for(i=0;i<a;i++)  
{  
c=c+pow(b,i)  
}  
}  
  
Void series::display()  
{  
Cout<<"The result is"<<c;  
}  
  
int main()  
{  
Series t;  
t.getdata();  
t.cal();  
t.display();  
return 0;  
}
```

INPUT

Enter the value of a:5

Enter the limit:2

OUTPUT

The result is=32

Experiment 4.write a program in c++ to find the reverse of a number.

To reverse a number in C++ programming, then you have to ask to the user to enter a **number**. Now, start **reversing** that **number** to find its **reverse** and then display its **reverse** on the screen. To **reverse** a **number**, first make a variable say rev and place 0 to rev initially, and make one more variable say rem.

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```
#include<iostream>

Usnig namespace std;

Class reverse

{

int n;

public:

voidgetdata();

void display();

};

Void reverse::getdata()

{

Cout<<"Enter the value n:";

Cin>>n;

}

Void display()

{

intr,s=0;

r=n%10;

n=n/10;

s=(s*10)+r;

cout<<"The reverse number is"<<s;

}

int main()

{

Reverse r;

r.getdata();

r.display();
```

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```
return 0;
```

```
}
```

INPUT

Enter the value of n:1234

OUTPUT

The reverse number is:4321

Experiment 5.A shop required to store information about each item. Information will be item code, price and available quantities. User (sales person) will store information about each item and can display information about each item. Model the above problem with OOP.

Into this programme there is only store and display concept of C++ Programming .

```
#include<iostream>
```

```
Using namespace std;
```

```
Class information
```

```
{
```

```
intc,p,q;
```

```
public:
```

```
voidgetdata();
```

```
void display();
```

```
};
```

```
Void information::getdata()
```

```
{
```

```
Cout<<"Enter the code of the item:";
```

```
Cin>>c;
```

```
Cout<<"Enter the item price:";
```

```
Cin>>p;
```

```
Cout<<"Enter the available quantities of item:";
```

```
Cin>>q;
```

```
}
```

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```
Void information::display()
{
cout<<"Item code:"<<c;
cout<<"Item price:"<<p;
cout<<"Quantities of item:"<<q;
}

int main()
{
Information i;
i.getdata();
i.display();
return 0;
}
```

INPUT

Enter the code of item:23

Enter the item price:1025

Enter the available quantites of item:10

OUTPUT

Item code:23

Item price:1025

Quantites of the item:10

Experiment6.A cricket organization need to store information like name, number of innings, number of not out innings, total run scored and total wicket taken of each cricketer. After storing data, organization will analyze the data and want to come on the following conclusion: If a cricketer plays more or equal inning and is batting average is more than 35 then recognize him as a “BATSMAN”. if a cricketer plays more or equal to 50 innings’ and if taken more than 49 wickets then recognize him as a”BOWLER”.if one satisfies both condition then he will be “ALL ROUNDER”. Organization needs to display each information about each cricketer. Model above problem using OOPs.

The syntax of an if...else statement in C++ is

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```
if(boolean_expression) {  
// statement(s) will execute if the boolean expression is true  
} else {  
// statement(s) will execute if the boolean expression is false  
}
```

```
if (testExpression)  
{  
// statements  
}
```

The if statement evaluates the test expression inside parenthesis.

If test expression is evaluated to true, statements inside the body of if is executed.

If test expression is evaluated to false, statements inside the body of if is skipped.

```
#include<iostream>
```

```
Using namespace std;
```

```
Class info
```

```
{
```

```
intn,i,p,w,a;
```

```
public:
```

```
voidgetinfo();
```

```
voiddisinfo();
```

```
};
```

```
Void info::getinfo()
```

```
{
```

```
Cout<<"Name of the player:";
```

```
Cin>>n;
```

```
Cout<<"Number of innings:";
```

```
Cin>>i;
```

```
Cout<<"Number of not out innings:";
```

```
Cin>>p;
```


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```
Cout<<"Batting average:";

Cin>>a;

Cout<<"Number of wickets:";

Cin>>w;

}

Void info::disinfo()

{

If(i>=50 && a>35)

{

Printf("BATSMAN");

}

Elseif(i>=50 && w>49)

{

Printf("BOWLER");

}

else((i>=50 && a>35)&&(i>=50 && w>49));

{

Printf("ALL ROUNDER");

}

}

int main()

{

Info i;

i.getinfo();

i.disinfo();

return 0;

}
```

INPUT

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Name of the player =ARUP CHOWDHURY

Number of innings:35

NUMBER OF NOT OUT INNINGS:52

Number of wicket:50

OUTPUT:BOWLER.

Experiment 7.Create a class will two private integer data member, initialize them with constructor. Now display data members with the help of function which is not a member of that class.

```
#include<iostream>
```

```
Using namespace std;
```

```
Class test
```

```
{
```

```
Inta,b;
```

```
Public:
```

```
test(intm,int n)
```

```
{
```

```
a=m;
```

```
b=n;
```

```
}
```

```
Friend intmean(test a1);
```

```
Friend intmean(test a2);
```

```
};
```

```
int mean1(test a1)
```

```
{
```

```
return (a1.b);
```

```
}
```

```
int main()
```

```
{
```

```
test a2;
```

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```
a2.getdata(10,20)

cout<<"The data are"<<"\n";

cout<< meam1(a2);

cout<<mean2(a2);

return 0;

}
```

OUTPUT

THE DATA ARE1020.

Experiment 8. Write a c++program to display the concept of function with default argument.

In C++programming, you can provide defaultvalues for function parameters. The ideabehind default argument is simple. If a function is called by passing argument/s, those arguments are used by the function. But if the argument/s are not passed while invoking a function then, the default values are used.

```
#include<iostream>

Using namespace std;

Class student

{

Inta,b;

Public:

Void getdata();

Void display();

};

Void student::getdata()

{

Cout<<"Enter the value of a:";

Cin>>a;

Cout<<"Enter the value of b:";

Cin>>b;

}
```

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```
Void student::display()
{
Cout<<"The value of a is:"<<a;
Cout<<"The value of b is:"<<b;
}

Intmain()
{
Student t;

t.getdata();

t.display();

return 0;

}
```

INPUT

ENTER THE VALUE OF A:12

ENTER THE VALUE OF B:13

OUTPUT

THE VALUE OF A IS:12

THE VALUE OF B IS :13

Experiment 9:-Create class 'fun' with one private float data member. initialize that data member with constructor. similarly create another class magic with private data member. initialize that data member with constructor. now using friend function check data member of which class is greater.

A non member function cannot have an access to the private data of a class. However, there could be a situation where we would like two classes to share a particular function. In such situations C++ allows the common function to be made friendly with both classes, thereby allowing the function to have access to private data of these classes. Such a function need be a member of any of these classes.To make an outside function "friendly" to a class, we have to simply declare this function as a friend of the class. The functions that are declared with the keyword friend are known as friend functions.

```
#include<iostream>
```

```
Using namespace std;
```

```
Class magic;
```

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Class fun

{

Float fun;

Public:

Fun()

{

Cout<<"Enter the value of a: ";

Cin>>a;

}

Friend void check(fun f, magic m);

};

Class magic

{

Float b;

Public:

Magic()

{

Cout<<"Enter the value of b: ";

Cin>>b;

}

Friend void check(fun f, magic m);

};

Void check(fun f, magic m)

{

If(f.a>m.b)

{

Cout<<"a is greater than b";

}

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```
Else if(f.a<m.b)
{
Cout<<"b is greater than a";
}
Else
{
Cout<<"both are same";
}
}
Intmain()
{
Fun f;
Magic m;
Check(f,m);
Return 0;
}
```

INPUT

Enter the value of a : 5

Enter the value of b: 10

OUTPUT

B is greater than a

Experiment 10. Create a class test with one private float data member initialize that data member with constructor similarly create another class testing with one private data member. Initialize that data member with constructor. Now using function swap the value of data member of the classes.

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```
#include<iostream>
```

```
Using namespace std;
```

```
Class testing;
```

```
Class test
```

```
{
```

```
Float a;
```

```
Public:
```

```
Test()
```

```
{
```

```
Cout<<"Enter the value of a: ";
```

```
Cin>>a;
```

```
}
```

```
Friend void check(testing t1, test t2);
```

```
};
```

```
Class testing
```

```
{
```

```
Float b;
```

```
Public:
```

```
Testing()
```

```
{
```

```
Cout<<"Enter the value of b: ";
```

```
Cin>>b;
```

```
}
```

```
Friend void check(testing t1, test t2);
```

```
};
```

```
Void check(testing t1, test t2)
```

```
{
```

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```
Int c;  
C=t2.a;  
T2.a=t1.b;  
T1.b=c;  
Cout<<"the value of a is: "<<t2.a;  
Cout<<"the value of b is: "<<t1.b;  
}  
Intmain()  
{  
Test t2;  
Testing t2;  
Check(t1, t2)  
Return 0;  
}
```

INPUT

Enter the value of a=5

Enter the value of b=10

OUTPUT

The value of a= 10

The value of b= 5

Experiment 11.write a c++ program to demonstrate the concept of single inheritance.

ALGORITHM:

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- Start the process
- Invoke the base class B
- Invoke the derived class D using public derivation
- Get the input data
- Display the inputted data
- Call the derived classes member functions
 - o Assign a new value for base classes data member
- Display the outputs
- Stop the process

```
#include<iostream.h>
#include<conio.h>
class B
{
int a;
public:
int b;
void get_ab();
int get_a();
void show_a();
};
class D: public B
{
int c;
public:
void mul();
void display();
};
void B::get_ab()
{
cout<<"Enter Values for a and b";
cin>>a>>b;
}
int B::get_a()
{
return a;
}
void B::show_a(){
cout<<"a= "<<a<<"\n";
}
void D::mul()
{
get_ab();
c=b*get_a();
}
void D:: display()
{
show_a();
cout<<"b= "<<b<<"\n";
cout<<"c= "<<c<<"\n\n";
}
```

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```
void main()
{
    clrscr();
    D d;
    d.mul();
    d.display();
    d.mul();
    d.display();
    getch();
}
```

OUTPUT

```
A=5
A=5
B=10
C=50
```

```
A=5
B=20
C=100
```

Another Example for single inheritance:

```
#include<iostream>
```

```
Using namespace std;
```

```
Class A
```

```
{
```

```
Int a;
```

```
Public:
```

```
Int b;
```

```
Void getdata(int m, int n)
```

```
{
```

```
A=m;
```

```
B=n;
```

```
}
```

```
Intget_a()
```

```
{
```

```
Return a;
```

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```
}  
  
Void show()  
  
{  
  
Cout<<a;  
  
}  
  
};  
  
Class B  
  
{  
  
Public:  
  
Void multiply()  
  
{  
  
Cout<<"The value of a: "<<get_a;  
  
Cout<<"The value of b:"<<b;  
  
Cout<<"Multiply= "<<b*get_a();  
  
}  
  
};  
  
Intmain()  
  
{  
  
B B1;  
  
B1.getdata(10,5);  
  
B1.multiply();  
  
Return 0;  
  
}
```

OUTPUT

The value of a: 10

The value of b: 5

Multiply= 50

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Experiment 12. Write a c++ program to demonstrate the concept of multiple inheritance.

ALGORITHM:

Step 1: Start the program.

Step 2: Declare the base class student.

Step 3: Declare and define the function get() to get the student details.

Step 4: Declare the other class sports.

Step 5: Declare and define the function getsm() to read the sports mark.

Step 6: Create the class statement derived from student and sports.

Step 7: Declare and define the function display() to find out the total and average.

Step 8: Declare the derived class object, call the functions get(), getsm() and display().

Step 9: Stop the program.

```
#include<iostream.h>
#include<conio.h>

class student
{
    protected:
        int rno,m1,m2;
    public:
        void get()
        {
            cout<<"Enter the Roll no :";
            cin>>rno;
            cout<<"Enter the two marks  :";
            cin>>m1>>m2;
        }
};

class sports
{
    protected:
        intsm;           // sm = Sports mark
    public:
        voidgetsm()
        {
            cout<<"\nEnter the sports mark :";
            cin>>sm;
        }
};

classstatement:publicstudent,public sports
{
    inttot,avg;
    public:
        void display()
        {
            tot=(m1+m2+sm);
            avg=tot/3;
            cout<<"\n\n\tRoll No   : "<<rno<<"\n\tTotal       : "<<tot;
```

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```
        cout<<"\n\tAverage   : "<<avg;
    }
};
void main()
{
    clrscr();
    statementobj;
    obj.get();
    obj.getsm();
    obj.display();
    getch();
}
```

Output:

Enter the Roll no: 100

Enter two marks

90

80

Enter the Sports Mark: 90

Roll No: 100

Total : 260

Average: 86.66

Another Example for multiple inheritance:

```
#include<iostream>
```

```
Using namespace std;
```

```
Class student
```

```
{
```

```
Introll ;
```

```
Public:
```

```
Void getroll();
```

```
{
```

```
Cout<<"Enter the roll:";
```

```
Cin>>roll;
```

```
}
```

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Void display()

{

Cout<<"The Roll is= "<<roll;

}

};

Class exam

{

Float marks1;

Public:

Void getmarks()

{

Cout<<"Enter the marks: ";

Cin>>marks1;

}

Void dispmarks()

{

Cout<<"\n the marks1 is: "<<marks1;

}

};

Class result: public student, public exam

{

Float marks2;

Public:

Void getmarks2()

{

Cout<<"\n enter the marks2";

Cin>>marks2;

}

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```
Void dispmarks2()
```

```
{
```

```
Cout<<"\n The marks2 is: "<<marks2;
```

```
}
```

```
Intmain()
```

```
{
```

```
Result r;
```

```
r.getroll();
```

```
r.disproll();
```

```
r.getmark1();
```

```
r.dispmark1();
```

```
r.getmark2();
```

```
r.dispmark2();
```

```
return 0;
```

```
}
```

INPUT

Enter the roll is: 1

Enter the marks1: 98

Enter the marks2: 87

OUTPUT

The roll is: 1

The mark1 is: 98

The mark2 is: 87

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Experiment 13. Write a c++ program to demonstrate the concept of MULTILEVEL inheritance.

In C++ programming, not only you can derive a class from the base class but you can also derive a class from the derived class. This form of inheritance is known as multilevel inheritance.

```
class A
{
... ..
};
class B: public A
{
... ..
};
class C: public B
{
... ..
};
```

Here, class B is derived from the base class A and the class C is derived from the derived class B.

Programme:

```
#include<iostream>
```

```
Using namespace std;
```

```
Class student
```

```
{
```

```
Int roll;
```

```
Public :
```

```
Void getdata()
```

```
{
```

```
Cout<<"Enter the roll is:";
```

```
Cin>>roll;
```

```
}
```

```
Void disroll()
```

```
{
```

```
Cout<<"The roll is="<<roll;
```

```
}
```

```
};
```


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Class exam:public student

{

Float marks;

Public:

Void marks()

{

Cout<<"Enter the marks1=";

Cin>>marks1;

}

Void dismarks1()

{

Cout<< "The marks is="<<marks1;

};

Class result:public exam

{

Float marks2;

Public:

Void getmarks2()

{

Cout<<"Enter the marks2 is=";

Cin>> marks2;

}

Void dismarks2()

{

Cout<< "The marks2 is="<<marks2;

}

};

Intmain()

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```
{  
result r;  
r.getroll();  
r.disroll();  
r.getmarks1();  
r.dismarks1();  
r.getmarks2();  
r.dismarks();  
return 0;  
}
```

INPUT

ENTER THE ROLL IS 80

ENTER THE MARKS1 IS 95

ENTER THE MARKS2 IS 90

OUTPUT

THE ROLL IS 80

THE MARKS1 IS 95

THE MARKS IS 90

Experiment 14. Write a c++ program to demonstrate the concept of HYBRID inheritance.

The method of combining any two or more forms of inheritance in single form is called hybrid inheritance.

```
class base  
{  
.....  
};  
class derived1 : public base  
{  
.....  
};  
class derived2 : public base  
{  
.....  
};  
class dervied3 : public derived1,derived2  
{
```

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.....
};

#include<iostream>

Using namespace std;

Class student

{

Protected:

Int roll;

Public:

Void getroll()

{

Cout<<"Enter the roll is:";

Cin>>roll;

}

Void disroll()

{

Cout<<"The roll is ="<<roll;

}

Class test:public student

{

Protected:

Int marks1;

Public:

Void marks1()

{

Cout<<"Enter the marks1=";

Cin>>marks1;

}

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```
Void dismarks1()
{
Cout<<"The marks1 is="<<marks1;
}
};

Class score
{
Protected:
Int marks2;
Public:
Void getmarks2()
{
Cout<<"Enter the marks2=";
Cin>>marks2;
}
Void dismarks2()
{
Cout<<"The marks2 is="<<marks2;
}
};

Class result:public test,public score
{
Protected:
Int t;
Public:
Void total()
{
t=marks1+marks2;
```

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```
}  
  
Void distotal()  
  
{  
  
Cout<<"The total is="<<t;  
  
}  
  
};  
  
Intmain()  
  
{  
  
result r;  
  
r.getroll();  
  
r.getmarks1();  
  
r.getmarks2();  
  
r.total();  
  
r.disroll();  
  
r.getmarks1();  
  
r.getmarks2();  
  
r.distotal();  
  
return 0;  
  
}
```

INPUT

ENTER THE ROLL IS 80

ENTER THE MARKS1 IS 90

ENTER THE MARKS2 IS 90

OUTPUT

THE ROLL IS 80

THE MARKS1 IS 90

THE MARKS2 IS 90

THE TOTAL IS 180

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Experiment15. An application needs to swap two integer and two float values using functions. Approach the above problem using functions with same name.

```
#include<iostream.h>

#include<conio.h>

class test
{
    inta,b;

    floatc,d;

    public:

    void swap(intm,int n)
    {
        a=m;

        b=n;

        cout<<"\n Now the value of a&b are"<<a<<"and"<<b<<"respctivly\n";

    }

    void swap(float p,floatq,float r)
    {
        c=p;d=q;

        cout<<"\n Now the value of c&d are"<<c<<"and"<<d<<"respctivly\n";

        c=c+d;

        d=c-d;

        c=c-d;

        cout<<"\n after swaping the value of e&d are"<<c<<"and"<<d<<"respctivly\n";

    }

    friend void show(test t2)

};

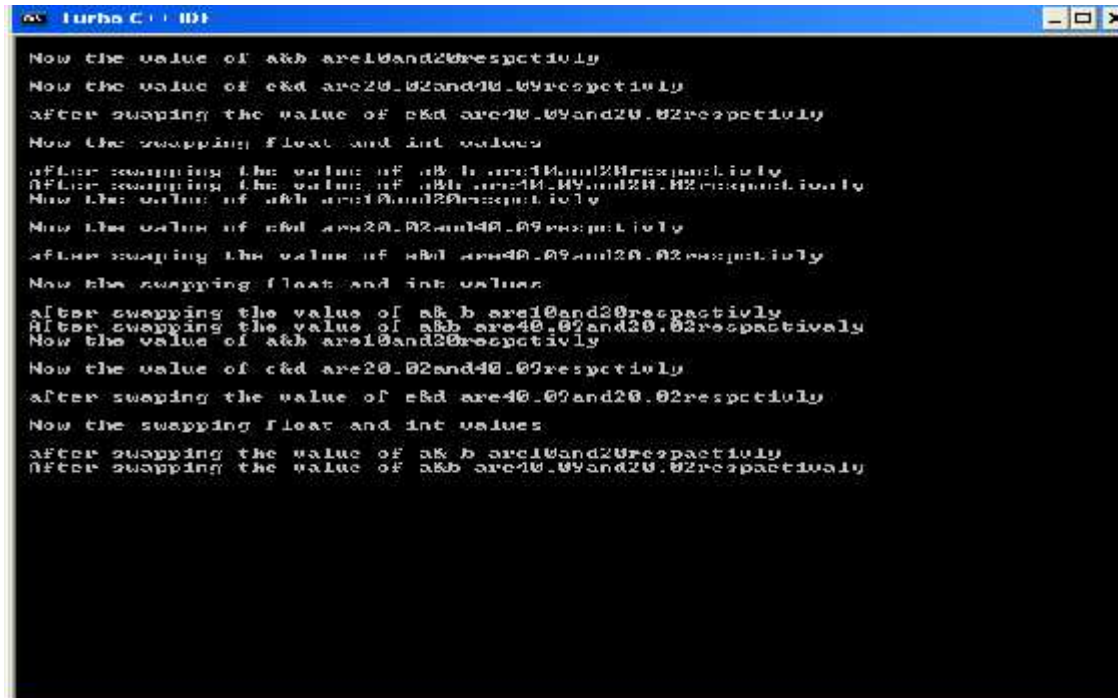
void show(test 2)
```

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```
{  
cout<<"\n Now the swapping float and int values\n";  
  
inte,f;  
  
e=t2.a;  
  
f=t2.b;  
  
cout<<"\n after swapping the value of a& b are"<<e<<"and"<<f<<"respactivly";  
  
floatx,y;  
  
x=t2.c;  
  
y=t2.d;  
  
cout<<"\n After swapping the value of a&b are"<<x<<"and"<<y<<"respactivly";  
  
}  
  
int main()  
{  
test t;  
  
t.swap(10,20);  
  
t.swap(20.02,40.09,50.66);  
  
show(t);  
  
getch();  
  
return 0;  
}  
  
Output:=
```

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```
Now the value of a&b are10and20respectively
Now the value of c&d are20.02and40.09respectively
after swapping the value of c&d are40.09and20.02respectively
Now the swapping float and int values
after swapping the value of a&b are10and20respectively
after swapping the value of a&b are40.09and20.02respectively
Now the value of a&b are10and20respectively
Now the value of c&d are20.02and40.09respectively
after swapping the value of c&d are40.09and20.02respectively
Now the swapping float and int values
after swapping the value of a&b are10and20respectively
after swapping the value of a&b are40.09and20.02respectively
Now the value of a&b are10and20respectively
Now the value of c&d are20.02and40.09respectively
after swapping the value of c&d are40.09and20.02respectively
Now the swapping float and int values
after swapping the value of a&b are10and20respectively
after swapping the value of a&b are40.09and20.02respectively
```

Experiment16. Write a program to calculate the number of objects created by your program.

```
#include<iostream.h>
#include<conio.h>
int count=0;
class test
{
public:
test()
{
count++;
cout<<"\n Object"<<cout<<"is created\n";
}

};
int main()
{
test t1;

{
test t1,t3;

}
getch();
return 0;
}
```


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Experiment 17. Write a C++ program to achieve the following thing. A class contains 3 data member of type integer. Use ++ and -- operator in a way so that whenever we use ++ with the object of, all data member will incremented by one. Similarly, -- will work.

Initially when the object *obj* is declared, the value of data member *i* for object *obj* is 0 (constructor initializes *i* to 0).

When ++ operator is operated on *obj*, operator function void operator++() is invoked which increases the value of data member *i* to 1.

```
#include<iostream.h>
#include<conio.h>
class test
{
    int a,b,c;
public:
    void getdata()
    {
        a=10;
        b=20;
        c=30;
    }
    void operator++()
    {
        a=a+1;
        b=b+1;
        c=c+1;
    }
    void operator--()
    {
        a=a-1;
        b=b-1;
        c=c-1;
    }
    void display()
    {
        cout<<"A"<<a;
        cout<<"B"<<b;
        cout<<"C"<<c;
    }
};
int main()
{
    test t;
    t.getdata();
    ++t;
    t.display();
    --t;
    t.display();
}
```

Lab Manual

The screenshot shows the Turbo C++ IDE with the following assembly code in the main window:

```

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```

In this program, three objects of type Complex are created and user is asked to enter the real and imaginary parts for two complex numbers which are stored in objects T1 and T2. Then statement `result = T1 - T2` is executed. This statement invokes the operator function `Complex operator -(Complex T2)`. When `result = T1 + T2` is executed, T2 is passed as argument to the operator function. In case of operator overloading of binary operators in C++ programming, the object on right hand side of operator is always assumed as argument by compiler.

```
#include<iostream.h>
#include<conio.h>
class test
{
floatx,y;
public:
test()
{}
test(float real,float image)
{
x=real;
y=image;
}
test operator+(test);
void display(void);
};
test test::operator+(test p)
{
test temp;
```

```
temp.x=x+p.x;
temp.y=y+p.y;
return temp;
}
void complex::display(void)
{
cout<<x<<"+"i"<<y;
}
int main()
{
test t1,t2,t3;
t1=test(5.8,8.4);
t2=test(9.3,12.8);
t3=t1+t2;
cout<<"\n t1=";
t1.display();
cout<<"\n t2=";
t2.display();
cout<<"\n t3=";
t3.display();
getch();
return 0;
}
```

Experiment19. Write a C++ program to demonstrate the concept of Virtual Class.

ALGORITHM:

- Step 1: Start the program.
- Step 2: Declare the base class student.
- Step 3: Declare and define the functions getnumber() and putnumber().
- Step 4: Create the derived class test virtually derived from the base class student.
- Step 5: Declare and define the function getmarks() and putmarks().
- Step 6: Create the derived class sports virtually derived from the base class student.
- Step 7: Declare and define the function getscore() and putscore().
- Step 8: Create the derived class result derived from the class test and sports.
- Step 9: Declare and define the function display() to calculate the total.
- Step 10: Create the derived class object obj.
- Step 11: Call the function get number(),getmarks(),getscore() and display().
- Step 12: Stop the program.

PROGRAM:

```
#include<iostream.h>
#include<conio.h>

class student
{
    intrno;
public:
    voidgetnumber()
    {
        cout<<"Enter Roll No:";
```

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```
        cin>>rno;
    }
    void putnumber()
    {
        cout<<"\n\n\tRoll No:"<<rno<<"\n";
    }
};
```

```
class test:virtual public student
{
```

```
    public:
    int part1,part2;
    void getmarks()
    {
        cout<<"Enter Marks\n";
        cout<<"Part1:";
        cin>>part1;
        cout<<"Part2:";
        cin>>part2;
    }
    void putmarks()
    {
        cout<<"\tMarks Obtained\n";
        cout<<"\n\tPart1:"<<part1;
        cout<<"\n\tPart2:"<<part2;
    }
};
```

```
class sports:public virtual student
{
```

```
    public:
    int score;
    void getscore()
    {
        cout<<"Enter Sports Score:";
        cin>>score;
    }
    void putscore()
    {
        cout<<"\n\tSports Score is:"<<score;
    }
};
```

```
class result:public test,public sports
{
```

```
    int total;
    public:
    void display()
    {
        total=part1+part2+score;
        putnumber();
        putmarks();
    }
};
```

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```
        putscore();
        cout<<"\n\tTotal Score:"<<total;
    }
};

void main()
{
    resultobj;
    clrscr();
    obj.getnumber();
    obj.getmarks();
    obj.getscore();
    obj.display();
    getch();
}
```

Output:

Enter Roll No: 200

Enter Marks

Part1: 90

Part2: 80

Enter Sports Score: 80

Roll No: 200

Marks Obtained

Part1: 90

Part2: 80

Sports Score is: 80

Total Score is: 250

Another example of virtual class.

```
#include<iostream.h>
#include<conio.h>
class student
{
    intrno;
public:
    voidgetnumber()
    {
        cout<<"Enter rollno";
        cin>>rno;
    }
    voidputnumber()
    {
        cout<<"\n Roll no"<<rno;
    }
};
```

```
classtest:virtual public student
{
public:
int part1,part2;
voidgetmark()
{
cout<<"\n enter marks:";
cout<<"\n part1:";
cin>>part1;
cout<<"\n part2";
cin>>part2;

}
voidputmarks()
{
cout<<"\n marks obtained:\n";
cout<<"\n part1:"<<part1;
cout<<"\n part2:"<<part2;
}
};
classsports:public virtual student
{
public:
int score;
voidgetscore()
{
cout<<"\n enter sports score";
cin>>score;
}
voidputscore()
{
cout<<"\n sports score is"<<score;
}
};
classresult:publictest,public sports
{
int total;
public:
void display()
{
total=part1+part2+score;
putnumber();
putmarks();
putscore();
cout<<"\n total score is":<<total;
}
};
int main()
{
result t;
t.getnumber();
t.getmark();
t.getscore();
t.display();
getch();
}
```

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```
return 0;  
}
```

Experiment 20. Write a C++ program to show how Run Time Polymorphism is achieved in C++.

```
#include<iostream.h>  
  
#include<conio.h>  
  
class shape  
{  
protected:  
    intx,y;  
public:  
    voidgetshape()  
    {  
        cout<<"Enter length";  
  
        cin>>x;  
  
        cout<<"Enter depth";  
  
        cin>>y;  
    }  
  
    virtual void area()=0;  
};  
  
classtriangle:public shape  
{  
    float c;  
public:  
    void area()  
    {  
        c=0.5*x*y;  
  
        cout<<c;
```

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```
}  
};  
int main()  
{  
    shape s;  
    triangle t;  
    s.getshape();  
    shape*ptr;  
    ptr=&s;  
    ptr->area();  
    ptr=&t;  
    ptr->area();  
    getch();  
    return 0;  
}
```


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Title of Course: Physics-II Lab

Course Code: PH291

L-T-P scheme: 0-0-3

Course Credit: 2

Objectives:

Engineering Physics students will:

- Excel in technical careers and thrive in graduate studies using scientific principles and application of physical sciences
- Work effectively in bringing multi-disciplinary ideas to diverse professional environments
- Improve their workplaces and communities, and the society through professional and personal activities
- be able to demonstrate competency and understanding of the basic concepts found in physics.
- be able to utilize the scientific method for formal investigation and to demonstrate competency with experimental methods that are used to discover and verify the concepts related to content knowledge.
- demonstrate skills necessary for conducting research related to content knowledge and laboratory skills.

Learning Outcomes:

- Upon completion, students will have:
- working knowledge of fundamental physics and basic electrical and/or mechanical engineering principles to include advanced knowledge in one or more engineering disciplines;
- the ability to identify, formulate, and solve engineering physics problems;
- the ability to apply the design process to engineering problems;
- the ability to formulate, conduct, analyze, and interpret experiments in engineering physics; and
- the ability to use modern engineering physics techniques and tools, including software and laboratory instrumentation.
- communicate their ideas effectively, both orally and in writing; and function effectively in multidisciplinary teams.
- an understanding of their professional and ethical responsibility to society;
- knowledge of the relationship between technology and society;
- a capacity and desire for life-long learning to improve themselves as citizens and engineers; and
- a knowledge of technical contemporary issues.

Course Contents:

Group - 1: Experiments on Electricity and Magnetism

1. Determination of dielectric constant of a given dielectric material.
2. Determination of resistance of ballistic galvanometer by half deflection method and study of variation of logarithmic decrement with series resistance.
3. Determination of the thermo-electric power at a certain temperature of the given thermocouple.
4. Determination of specific charge (e/m) of electron by J.J. Thomson's method.

Group - 2: Quantum Physics

5. Determination of Planck's constant using photocell.
6. Determination of Lande' g factor using Electron spin resonance spectrometer.

7. Determination of Stefan's radiation constant.
8. Verification of Bohr's atomic orbital theory through Frank-Hertz experiment.
9. Determination of Rydberg constant by studying Hydrogen/ Helium spectrum.

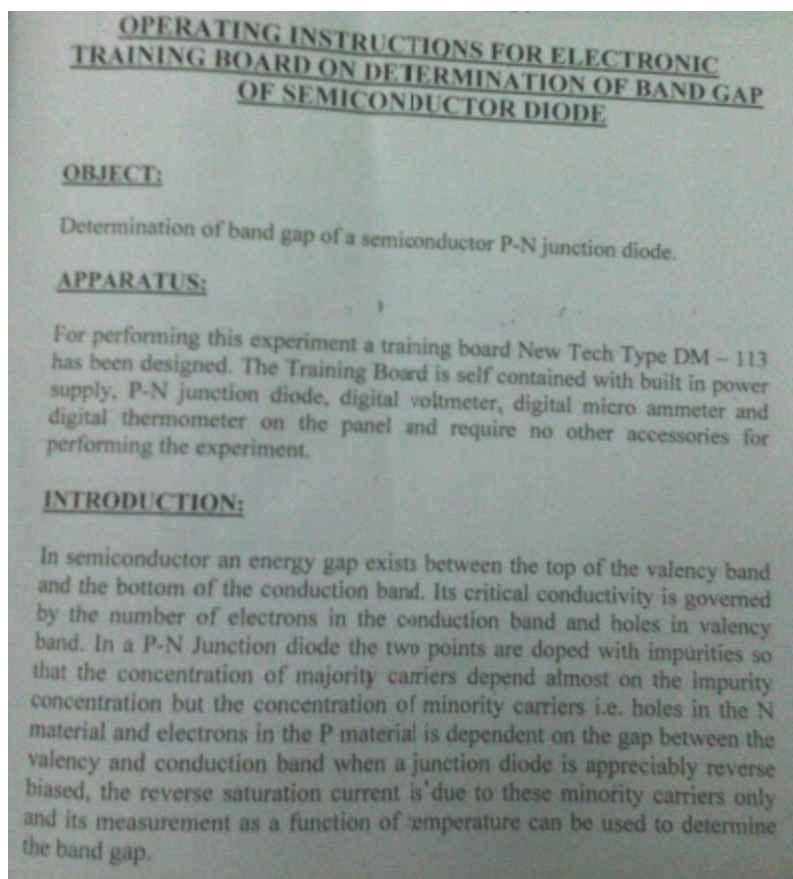
Group - 3: Modern Physics

10. Determination of Hall co-efficient of semiconductors.
11. Determination of band gap of semiconductors.
12. To study current-voltage characteristics, load response, areal characteristics and spectral response of photo voltaic solar-cells..

Text Book:

1. Basic Engineering Physics – Pal & Bhattacharya
2. B. Sc. Practical Physics

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THEORY:

When a P-N junction diode is reverse biased the reverse saturation current I_s is due to the minority carriers i.e. electrons in P semiconductor and holes in N semiconductor. The reverse saturation current depends on the temperature of junction diode and the band gap. The reverse saturation current:

$$I = A_s e^{-q\Delta E/KT}$$

$$\text{Or } \log_e I = \log_e A_s - q\Delta E/KT$$

Where ΔE is band gap in eV

$$\log_{10} I = \log_{10} A_s - 5.036 (\Delta E) (10^3 / T)$$

$$q = 1.6 \times 10^{-19} \text{ C}, \quad K = 1.38 \times 10^{-23} \text{ J/K}$$

Therefore graph plotted between $\log_{10} I$ and $(10^3/T)$ is a straight line whose gradient i.e. tangent of slope:

$$S = 5.036 (\Delta E) (AB / BC) \quad \text{Fig. (2)}$$

$$\text{or } \Delta E = 1 / 5.036 (AB / BC) \text{ ev (1)}$$

METHOD:

1. Plug the mains lead to the mains socket carrying 220 Volt, 50 Hertz A.C.
2. Connect the digital voltmeter and digital micro ammeter at proper places with the help of two connecting leads.
3. Now put the power ON/OFF switch to ON position.
4. Some suitable reverse bias voltage is applied or maximum reverse bias is applied. Note down the reverse bias voltage and it is to be kept

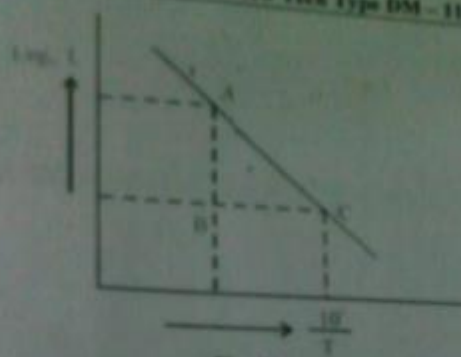


Fig. (1)

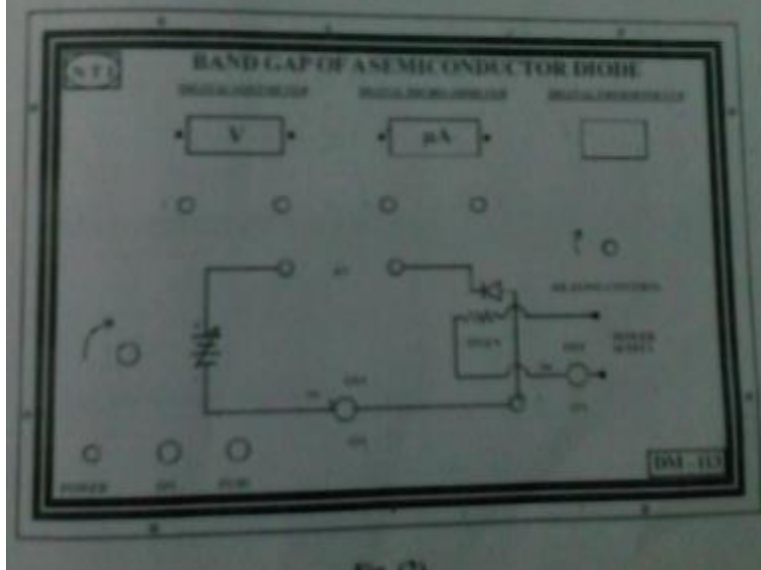


Fig. (2)

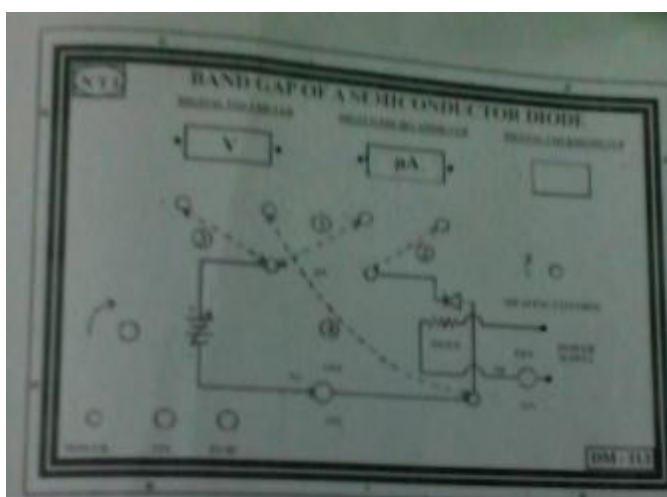


Fig. (3) Connections for Band Gap of a Semiconductor Diode

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OBJECT

To study charging and discharging of a condenser and determine time-constant.

APPARATUS

Circuit board or a Bread board containing low voltage D.C. power supply E_{DC} , Voltmeter and Ammeter, Three condensers C_1 , C_2 , C_3 three resistors R_1 , R_2 , R_3 , Switches SW_1 , SW_2 and SW_3 .

THEORY AND FORMULA

In Figure (19.1) when the switch SW_1 is switched on the condenser C charges. At time t the charge on the condenser –

$$Q = Q_0 (1 - e^{-t/RC})$$

and

$$I = I_0 e^{-t/RC}$$

During charging of a condenser charge increases exponentially with time while the current decreases exponentially. At time equal to time constant i.e.

$$t = t_c = RC$$

Where R is the resistance & C is the capacitance of the condenser.

$$Q = 0.63 Q_0$$

$$\text{and } I = 0.37 I_0$$

Where Q_0 and I_0 are the maximum values of charge and current during charging of the condenser.

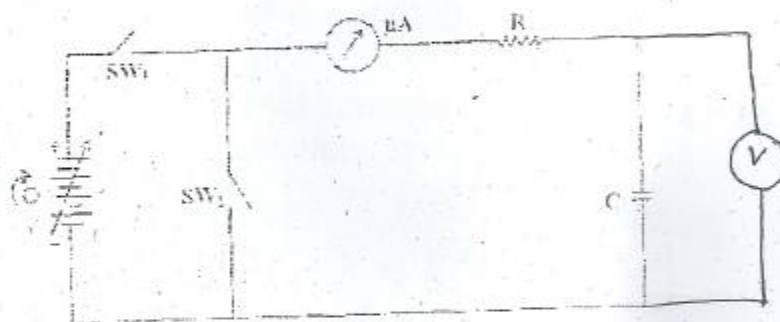
Now if the switch SW_1 is kept off and switch SW_2 is kept switched on the discharge of condenser takes place. During discharge of condenser at time t the charge and current are noticed as –

$$Q = Q_0 e^{-t/RC}$$

$$\text{and } I = I_0 e^{-t/RC}$$

That is during discharge of condenser the charge exponentially decrease and the current increases exponentially on negative side.

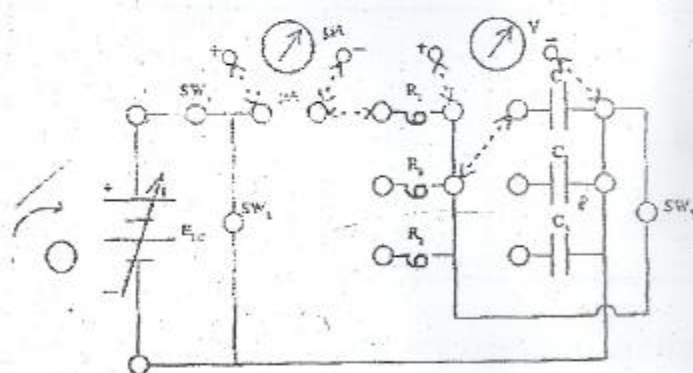
FIGURE



PROCEDURE

1. Connect the electronic circuit board (or a Bread board with necessary components) to A.C. supply and switch it on. Connect voltmeter across the power supply. Adjust the voltage of D.C. supply to full scale deflection in voltmeter.
2. Make connection as shown in Figure (19.2) use R_1 and C_1 .
3. Switch on the switch SW_1 and start stop watch simultaneously. Note down the readings of micro/milliammeter i.e. the charging current regularly after equal interval of time till the ammeter reading becomes zero.
4. Now switch off SW_1 (the internal connections are such that when SW_1 is OFF, SW_2 is ON). Therefore there is no need to

- switch on SW_2 when SW_1 is switched off. Start stop watch simultaneously. Note down the current at regular intervals of time till the current becomes zero from its negative maximum value. These are values of current at different times during discharge of condenser. Observations are taken for R_2, C_2 and R_3, C_3 similarly.
5. Switches SW_1 and SW_2 are switched off. Now press the SW_3 so that the condenser is completely discharged.
 6. Connect the voltmeter across the condenser and repeat steps (3) and (4). Note down the values of voltages at different regular intervals of time during charging and discharging of condenser. Similarly take observations for R_2, C_2 and R_3, C_3 .
 7. Tabulate the readings and plot graphs between Q and T and I & t for different pairs of R and C . Graphs as shown in Figure (3) and (4) are obtained.
 8. Calculate the value of time constant using relation $t = RC$ and from the graphs using relation (3).



Different Values

$R_1 = \dots\dots\dots K\Omega,$
 $R_2 = \dots\dots\dots K\Omega,$

$C_1 = \dots\dots\dots \mu f,$
 $C_2 = \dots\dots\dots \mu f,$

OBSERVATIONS

Observation Table of Charging of Condenser.

S.No	Time t	R ₁ =KΩ C ₁ =μf			R ₂ =KΩ C ₂ =μf		
		V _c (volt)	I _c (Amp)	Q-CI V _c (Coulomb)	V _c (volt)	I _c (Amp)	Q-CI V _c (Coulomb)
1.							
2.							
3.							
4.							

Similar observation table is made for readings during discharging of condensers.

CALCULATIONS

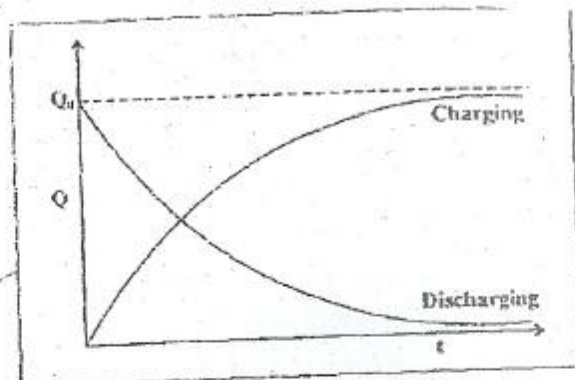
Theoretical values of time constants :

$$t_1 = R_1 C_1 = \dots\dots\dots \text{sec.}$$

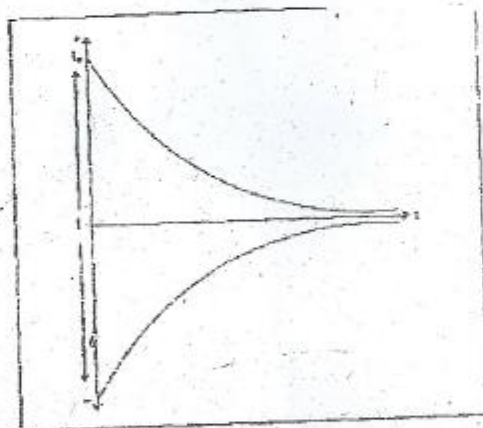
$$t_2 = R_2 C_2 = \dots\dots\dots \text{sec.}$$

Calculate time constants from the graphs also.

RESULT



Graphs between Q and t during charging and discharging of condenser



Graphs between I & t during charging and discharging of condenser

The values of time constants from graphs are :

$t_1 = \dots\dots\dots \text{sec.}$ $t_2 = \dots\dots\dots \text{sec.}$

And the theoretical values are :

$t_1 = \dots\dots\dots \text{sec.}$ $t_2 = \dots\dots\dots \text{sec.}$

The graphs between Q and t and I & t during charging and discharging of condenser show that their variations are exponential.

PRECAUTIONS

1. The reading of stop-watch should be very carefully taken. As the clock/watch is not synchronized with the apparatus, we should be more careful in manual handling.
2. While discharging the condenser, current suddenly changes. Thus, note current readings quickly and accurately.

DETERMINATION OF DIELECTRIC CONSTANT BY USING SPOT GALVANOMETER

OBJECT :-

To determine the dielectric constant of a medium using a spot galvanometer.

APPARATUS :-

New Tech Type electronic training board NTI - 410, one spot galvanometer and two capacitors-one without dielectric and other with dielectric. In the training board I.C. regulated power supply and required number of keys are provided. The set up is complete in itself and no other item is required to perform the experiment.

3. THEORY :-

Let a condenser without dielectric i.e. placed in air of capacity C_a is first charged to a potential V and then discharged through a spot galvanometer. Let this charge Q_1 produces a throw θ_1 in the galvanometer, then we have,

$$Q_1 = C_a V = K \theta_1 (1 + \frac{1}{2} \lambda) \quad (1)$$

Now the same condenser with some solid dielectric is used. Since the medium is changed so its capacity is changed, let its capacity be C_m . The condenser is again charged to the same potential V and then discharged through the spot galvanometer. Let this time charge Q_2 produces a throw θ_2 in the galvanometer, then we have

$$Q_2 = C_m V = K \theta_2 (1 + \frac{1}{2} \lambda) \quad (2)$$

Dividing (2) by (1)

$$C_m V / C_a V = K \theta_2 (1 + \frac{1}{2} \lambda) / K \theta_1 (1 + \frac{1}{2} \lambda)$$

Operating Instructions for New Tech Type NTI – 410

$$C_m / C_a = \theta_2 / \theta_1$$

$$\text{Because } C_m / C_a = \epsilon_r$$

Therefore Dielectric constant of the medium is

$$\epsilon_r = C_m / C_a = \theta_2 / \theta_1 \quad \text{---(3)}$$

Using this formula the dielectric constant of the solid medium is calculated.

4. PROCEDURE :

1. The condenser without dielectric is connected in between A, B terminals and spot galvanometer is connected in between C, D terminals of the electronic training board.
2. The spot galvanometer and the training board are connected to A.C. supply.
3. The spot is adjusted at zero.
4. keeping the power supply at some suitable value first press switch S_{w1} for some time after releasing the press switch S_{w1} press key S_{w2} immediately. It produces a throw of θ_1 .
5. Now the capacitor with dielectric is connected in between A & B in place of capacitor without dielectric. Again key S_{w1} is pressed for same time as earlier. Then it is released and the key S_{w2} is pressed immediately. This time θ_2 throw is obtained.
6. θ_1 and θ_2 are noted several times and their mean values are calculated. Using formula (3) the dielectric constant of the medium is calculated.

Operating Instructions for New Tech Type NTI – 410

5. OBSERVATIONS :-

S.No.	Throw when capacitor without dielectric is used θ_1 cm	Throw when capacitor with dielectric is used θ_2 cm
1.		
2.		
3.		
4.		
5.		

Mean θ_1 = _____ mean θ_2 = _____

6. CALCULATIONS :-

Dielectric constant is given by formula :

$$\epsilon_r = \theta_2 / \theta_1$$

Using this dielectric constant of the medium is calculated.

7. RESULT :-

The dielectric constant of the medium _____ as determined by using spot galvanometer is = _____

Standard value = 2

8. PRECAUTIONS :-

1. The spot galvanometer should be will levelled so that the motion of its coil is free.
2. Initially the spot must be at zero of the scale.

Operating Instructions for New Tech Type NTI – 410

Every time after pressing the Press switch Sw_2 i.e. after discharging the condenser through spot galvanometer keeping switches Sw_1 and Sw_2 unpressed do short circuit A, B to completely discharge the condenser then start further procedure.

4. Throws θ_2 and θ_1 should be taken quite large by adjusting the charging voltage of D.C. power supply.
5. Using galvanometer key K_G / Sw_G the coil is brought to rest position soon.

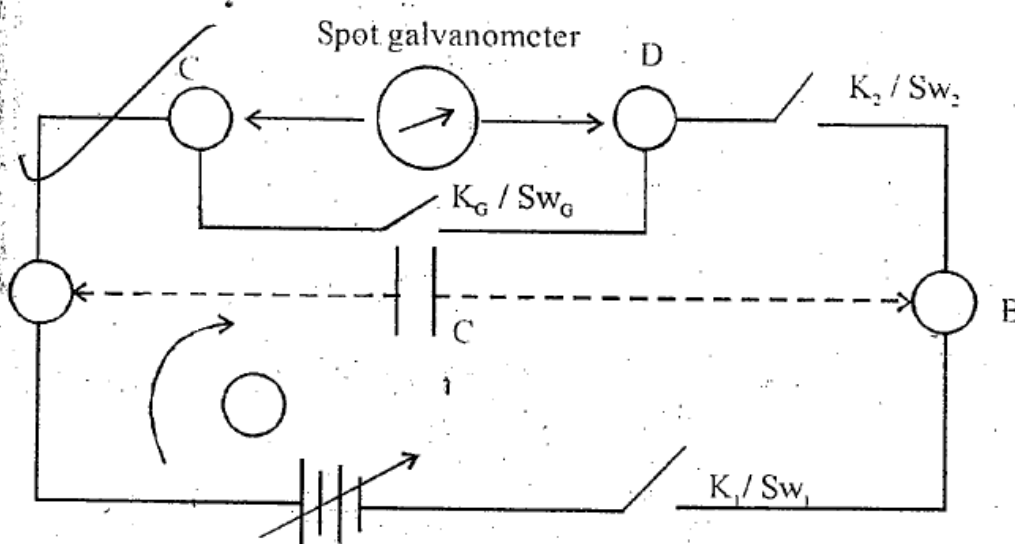


Figure: (1) Circuit Diagram

OPERATING INSTRUCTIONS

FOR e/m BY

THOMSON'S METHOD

OBJECT :

To determine e/m by Thomson's method.

APPARATUS :

The setup New Tech Type DM - 114 consists of:

1. **CATHODE RAY TUBE:** A cathode Ray Tube is mounted on a wooden stand which has a groove cut at its bottom to fit into another stand with platform for placing two bar magnets. This stand is at right angles to the CRT. The third wooden stand provides a platform for magnetometer for measuring the magnetic field along the axis of the CRT.

CONSTANTS OF CATHODE RAY TUBE:

Type of cathode ray tube: ...DG-7152A...

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Operating Instructions for New Tech Type DM-114

Length of Deflection Plates = 2 Cms

Space between deflection plates = 0.4 Cms

Distance between the edge of the

deflection plates and the screen = 16.0 Cms

2. **POWER SUPPLY UNIT:** It provides all the voltages necessary to operate the CRT. Intensity, Focussing controls are there on the panel. There is also deflecting voltage control required to deflect the electron beam. This voltage can be measured by connecting a high resistance voltmeter (20,000 ohms per volt) to the terminals marked Def - Volts. The voltages on the deflection plates are interchangeable by the switch 'Reverse' so as to deflect the beam either upward or downward. X shift control is also there to shift the spot horizontally. It is only to adjust the spot on the scale.

THEORY :

Consider that the beam of electrons having charge 'e', mass 'm' is moving along the axis of the CRT and enters through a pair of plates maintained at a constant potential difference v volts. If 'd' is the distance between the deflecting plates. The electric field in between the plates:

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Operating Instructions for New Tech Type DM-114

$$E = \frac{v}{d} \text{ and the force on the electrons } F = eE$$

As this force is perpendicular to initial velocity v of electrons, hence the velocity v must remain constant. In the field the electrons travel a distance ' l ' equal to the length of the plates.

Let the time taken by electrons to travel the distance ' l ' is ' t '

$$l = vt \quad \dots\dots\dots (1)$$

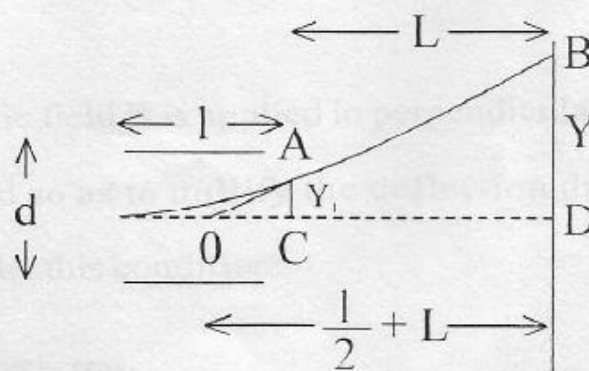
The acceleration along the direction of the field $f = \frac{eE}{m}$

Distance travelled in the direction of the field in time ' t ' i.e. at the end of deflecting plates is:

$$Y_1 = \frac{1}{2} \frac{eE}{m} t^2$$

Putting value of ' t ' from (1)

$$Y_1 = \frac{1}{2} \frac{eE l^2}{mv^2} \quad \dots\dots\dots (2)$$



Where Y is the deflection on the screen in the direction of the electric field.

Operating Instructions for New Tech Type DM-114

From Fig. $\frac{Y}{Y_1} = \frac{L + \frac{l}{2}}{\frac{l}{2}}$

or $Y = \frac{(L + \frac{l}{2})}{\frac{l}{2}} Y_1$

or $Y = \frac{\left(\frac{l}{2} + L\right)}{\frac{l}{2}} \frac{1}{2} \frac{eEl^2}{mv^2}$

or $Y = \frac{\left(\frac{l}{2} + L\right) eEl}{mv^2}$

or $e/m = \frac{v^2 Y}{\left(\frac{l}{2} + L\right) El} \dots\dots\dots (3)$

Now magnetic field B is applied in perpendicular direction to the electric field so as to nullify the deflection due to deflecting voltage. Under this condition:

$$Ee = Bev$$

Operating Instructions for New Tech Type DM-114

$$\text{or } v = \frac{E}{B}$$

Putting the value of v in (3)

$$e/m = \frac{E^2 Y}{B^2 \left(\frac{l}{2} + L \right) El}$$

$$\text{or } \frac{e}{m} = \frac{EY}{B^2 l \left(\frac{l}{2} + L \right)}$$

$$\text{Putting } E = \frac{v}{d}$$

$$e/m = \frac{VY}{dB^2 l \left(\frac{l}{2} + L \right)} \dots\dots\dots (4)$$

To measure B the CRT is removed and in place of it a Compass Box is arranged. If deflection of the needle in Tan A position be θ and B_e is the horizontal component of earth's magnetic field. Then:

$$B = B_e \tan \theta$$

Substituting the value of B in (4)

Operating Instructions for New Tech Type DM-114

$$e/m = \frac{VY}{d B e^2 \tan^2 \theta l \left(\frac{l}{2} + L \right)} \text{ Coulomb/K. Gm..... (5)}$$

PROCEDURE :

1. Place the CRT on the wooden stand just fitting in the groove at its bottom. The direction of the CRT should be North-South i.e. CRT is in magnetic meridian. This will make horizontal component of earth's magnetic field along the direction of electron beam and it would not be affected by it.
2. Record the constants of the CRT.
3. Connect the power supply unit to the CRT and adjust intensity. Focus the spot on the screen at the centre when no potential difference is applied to the deflecting plates.
4. Apply some suitable P. D. between the deflection plates so as to get the deflection of beam 1 to 2 Cms. Measure the P. D. and corresponding vertical deflection Y.
5. Place two bar magnets symmetrically and equidistant on the arms of the stand so as to reduce the deflection to zero.

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Note down the positions of the magnets.

6. Remove magnets and reverse the deflecting P. D. Measure deflection of the spot in opposite direction.
7. Again place the magnets symmetrically to reduce the deflection in opposite direction and note down the positions of the magnets.
8. Switch off the power supply and take out the CRT.
9. Put a compass box at the same height as that of CRT adjust it in Tan A position of Gauss. Place the magnets exactly at the position of step 5 and find deflection of pointer readings of both ends.
10. Now Place the magnets at positions of step 7 and note the deflection of the pointer.
11. Find average of deflection as measured in steps 9 and 10.
12. The experiment may be repeated for different values of P.D. 'V'.

∴ Calculate e/m using relation (5).

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(C) Determination of Magnetic Field :

Sr. No.	Deflection in Compass Box					Magnetic Field $B = B_e \tan \theta$
	For direct V when Magnets are on $S_1 + S_2$ arm		For reverse v' When magnets on $S_1 + S_2$ arm		Mean deflection	
	One end of pointer θ_1 deg.	Other end θ_2 deg.	One end of pointer θ_1'	Other end θ_2'	$\frac{\theta_1 + \theta_2 + \theta_1' + \theta_2'}{4}$	

CALCULATIONS :

Calculate e/m using relation (5)

RESULT :

e/m = Coulomb/K Gm.

Standard value of e/m = 1.76×10^{11} Coulomb/K Gm.

OPERATING INSTRUCTIONS FOR PLANCK'S CONSTANT BY PHOTO CELL

OBJECT:

To determine the value of Planck's Constant using a photo cell.

APPARATUS:

New Tech Type Experimental setup EM - 101, consists of a training board New Tech Type EM - 101 which consists an IC Regulated power supply, two double range meters and necessary number of sockets. A mounted photo cell, a light source and set (Three) of filters with stands to be fixed on optical bench.

FORMULA OR THEORY:

From Einstein's Photo Electric Equation:

$$\frac{1}{2} mv^2 = h\nu - h\nu_0$$

$$\frac{1}{2} mv^2 = eV_0$$

$$eV_0 = h\nu - h\nu_0 \dots\dots\dots (1)$$

$$V_0 = (h/e) \nu - (h/e) \nu_0 \dots\dots\dots (2)$$

m - mass of electron

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Operating Instructions for New Tech Type EM – 101

h – Planck's constant

ν – Frequency of incident radiation

ν_0 – Threshold Freq.

V_0 – Stopping Potential

v – Velocity of photo electrons

e – electronic charge

The equation represents a straight line ($Y = mx - c$)

The slope of this straight line:

$$\tan \theta = h/e$$

$$h = e \tan \theta \quad \dots\dots\dots (3)$$

From (1)

$$eV_0 = hc/\lambda - h\nu_0$$

c – Velocity of light, λ – Wavelength of radiation

V_1 and V_2 are the stopping potentials for radiations of wavelengths λ_1 & λ_2 respectively:

$$eV_1 = hc/\lambda_1 - h\nu_0 \quad \dots\dots\dots (4)$$

$$eV_2 = hc/\lambda_2 - h\nu_0 \quad \dots\dots\dots (5)$$

From (3) and (4) :

Operating Instructions for New Tech Type EM – 101

$$e (V_2 - V_1) \lambda_1 \lambda_2 / c (\lambda_1 - \lambda_2) \dots\dots\dots (6)$$

PROCEDURE:

1. Photo cell and source of light on optical bench adjust these at same height.

2. Make the connections as shown in the Fig. (1)/(5). Care should be taken while connecting the various components, about the polarity of the photo cell and the meters.

3. The light from the source of light is allowed to fall on the photo cell. Now a suitable optical filter of known wavelength say Blue is placed between photo cell and source of light. The filter is placed near the photo cell.

4. A deflection is observed in the micro-ammeter. This deflection corresponds to the zero anode potential.
5. A small negative potential is applied to the anode. This voltage is recorded with the help of the voltmeter provided.
6. The negative anode potential is gradually increased in steps and each time corresponding deflection is noted till the micro-ammeter deflection reduces to zero.
7. The experiment is repeated with the other two filters provided.
8. Taking negative stopping potentials V_0 on Y axis and the frequency of incident radiation ν on X axis plot a graph. Find out the slope of the straight line. Calculate Planck's Constant using the relation (3). Fig. (2).
9. Planck's Constant can also be calculated from relation (6).

Graph between Anode Potentials (V) and photo electric Currents (I) also be plotted taking these on X and Y axis respectively. Fig. (3).

NOTATIONS:

$$e = 1.6 \times 10^{-19} \text{ Coulombs.}$$

$$c = 3 \times 10^8 \text{ M/ Second}$$

$$\text{Wavelength of Yellow filter} = 5400 \times 10^{-8} \text{ Cm.}$$

$$\text{Wavelength of Green filter} = 5200 \times 10^{-8} \text{ Cm.}$$

$$\text{Wavelength of Blue filter} = 5100 \times 10^{-8} \text{ Cm.}$$

$\lambda_1 = \dots\dots\dots \text{cm.}$		$\lambda_2 = \dots\dots\dots \text{cm.}$		$\lambda_3 = \dots\dots\dots \text{cm.}$	
Anode Potential Volt	Photoelectric Current μA	Anode Potential Volt	Photoelectric Current μA	Anode Potential Volt	Photoelectric Current μA

Operating Instructions for New Tech Type EM – 101

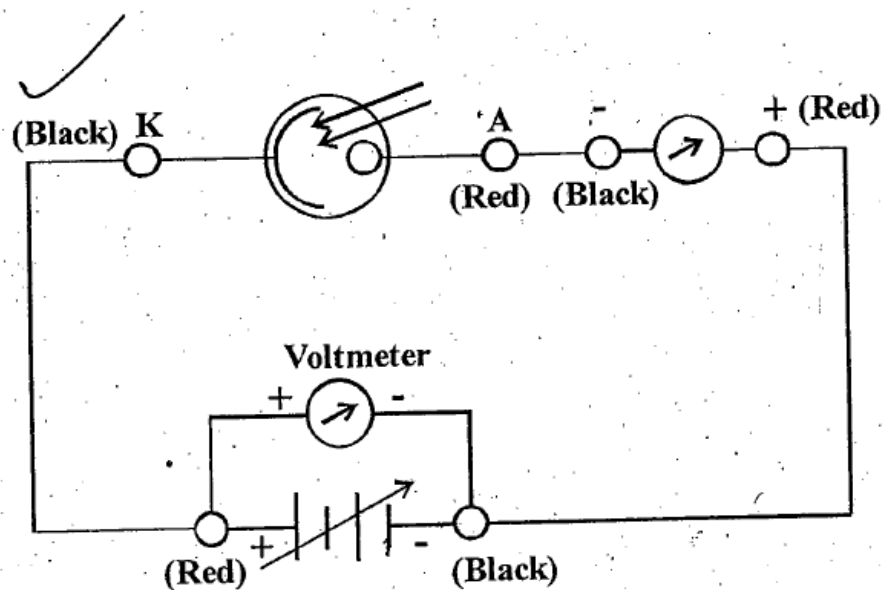


Fig. (1)

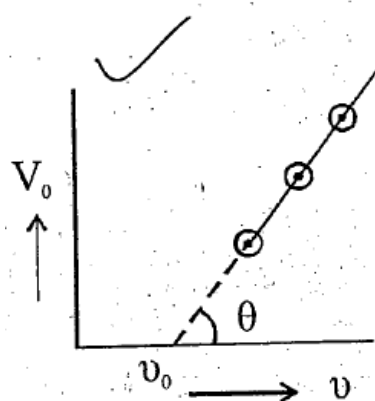


Fig. (2)

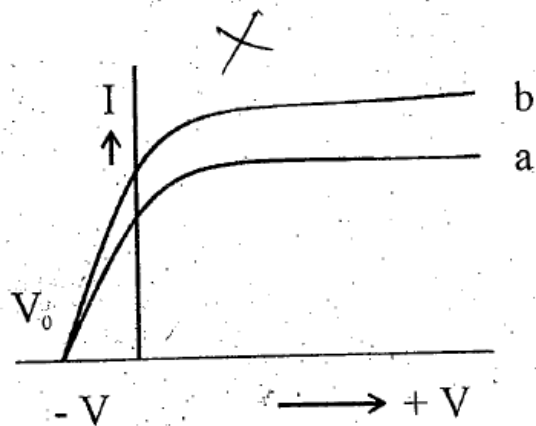


Fig. (3)

OPERATING INSTRUCTIONS FOR DETERMINATION OF RESISTANCE OF BALLISTIC GALVANOMETER BY HALF DEFLECTION METHOD & STUDY OF VARIATION OF LOGARITHMIC DECREMENT WITH SERIES RESISTANCE

OBJECT:

To determine resistance of a ballistic galvanometer by half deflection method and study of variation of logarithmic decrement with series resistance.

APPARATUS:

The New Tech Type NTI SETUP – 425 consists of (1) Training board NTI – 425 (2) Ballistic Galvanometer (3) Lamp & Scale Arrangement. The training board comprises a variable D.C. voltage source E , sockets, two on-off switches Sw_1 and Sw_2 , shunt resistances R_1 , 1 to 10, 10 to 100 Ohms and a variable high resistance R : $0.1\text{ K}\Omega \times 10$, $1\text{ K}\Omega \times 10$. Two sockets are provided for connecting B.G.. In between the sockets a tapping key/Switch is connected. The setup is complete in itself and no other accessory is required to perform the experiment.

THEORY:

RESISTANCE OF BALLISTIC GALVANOMETER BY HALF DEFLECTION METHOD:

From Fig. (1) switch Sw_1 is on and switch Sw_2 is off. Let resistance R is applied and deflection in ballistic galvanometer is $\theta = n$ Even Number of Divisions. Then current flowing through galvanometer is:

Operating Instructions for New Tech Type NTI SETUP - 425

$$I_1 = \frac{E}{R + G} \dots\dots\dots (1)$$

Where $E = \text{E.M.F. of D.C. Source}$

$G = \text{Resistance of ballistic Galvanometer.}$

Now switch Sw_2 is kept on and some resistance R_1 is introduced so that the deflection of ballistic galvanometer becomes half i.e. $\theta = n/2$.

Current flowing through ballistic galvanometer is $I_2 = \frac{R_1}{G + R_1} I$.

Where I is the total current flowing in the circuit and $I = \frac{E}{R + \frac{GR_1}{G + R_1}}$

$$\text{Or } I_2 = \frac{R_1}{G + R_1} \cdot \frac{E}{R + \frac{GR_1}{G + R_1}}$$

$$\text{Or } I_2 = \frac{R_1 E}{(G + R_1) R + GR_1} \dots\dots\dots (2)$$

$$\therefore I_2 = \frac{1}{2} I_1$$

$$\text{Or } I_1 = 2 I_2$$

\therefore From Equation (1) and (2)

$$\frac{E}{R + G} = \frac{2R_1 E}{(G + R_1) R + GR_1}$$

$$\text{Or } GR + RR_1 + GR_1 = 2RR_1 + 2GR_1$$

$$\text{Or } GR - GR_1 = RR_1$$

$$\text{Or } G = \frac{RR_1}{R - R_1}$$

$$\text{If } R_1 \ll R$$

$$\therefore G = R_1 \text{ Ohms} \dots\dots\dots (3)$$

i.e. ballistic galvanometer resistance is equal to the shunt resistance for half deflection.

LOGARITHMIC DECREMENT:

The logarithmic decrement is given by

$$\lambda = \frac{2.3026}{10} \log_{10} \frac{\theta_1}{\theta_{11}}$$

if a lamp and scale arrangement is used and d_1, d_{11} are the first and eleventh throws of the spot of light on the scale placed at distance D then

$$\theta_1 = \frac{d_1}{2D} \text{ and } \theta_{11} = \frac{d_{11}}{2D}$$

$$\frac{\theta_1}{\theta_{11}} = \frac{d_1}{d_{11}}$$

$$\text{then } \lambda = \frac{2.3026}{10} \log_{10} \frac{\theta_1}{\theta_{11}} = \frac{2.3026}{10} \log_{10} \frac{d_1}{d_{11}} \dots\dots\dots (4)$$

The logarithmic decrement can be determined with 0 resistance or some resistance in series with ballistic galvanometer. Thus the effect of series resistance on logarithmic decrement can be studied.

Operating Instructions for New Tech Type NTI SETUP - 425

PROCEDURE:

DETERMINATION OF G:

1. To determine the resistance of ballistic galvanometer by half deflection method rig up the circuit on the panel of board as shown in Fig. (1). High resistance R in kilo ohms is to be used.
2. Switch on A.C. supply. LED glows indicating that the apparatus is ready to work. Keep the knob of DC source E at some suitable position and measure E. Keep the value of E low.
3. Switch on the switch Sw_1 and adjusting the value R get deflection in galvanometer $\theta = n$ divisions. The deflection should be equal to even number of divisions. Keep Sw_2 switch off during this.
4. Now switch on the switch Sw_2 and connect some suitable resistance R_1 so that deflection of galvanometer is reduced to half $n/2$. This resistance R_1 is equal to galvanometer resistance i.e. $R_1 = G$.
5. Repeat the steps No.3 and 4 for different values of R. At least five sets of R and R_1 should be taken.
6. Calculate the value of G from every set of observations.

STUDY OF LOGARITHMIC DECREMENT WITH SERIES RESISTANCE:

1. Rig up the circuit as soon in Fig. (1)
2. Keep the value of DC source voltage E low.
3. Keep the series resistance R equal to zero.
4. After switching ON the switch Sw_1 switch it OFF immediately.
5. Note first and eleventh throws – d_1 and d_{11} of the spot on the scale of lamp and scale arrangement.

Operating Instructions for New Tech Type NTI SETUP - 425

6. Calculate the value of logarithmic decrement using formula No. (4).
7. Repeat the experiment with different values of series resistance and determine logarithmic decrement.

OBSERVATIONS:

OBSERVATIONS FOR G:

Sr. No.	High Res. R Ohm	Galv. Defl. $\theta = n$ Div.	Res. for Half Defl. $R_1 = G$ Ohm	Mean G Ohm
1.				
2.				
3.				

OBSERVATIONS FOR λ :

Sr. No.	High Res. R Ohm	d_1 Cm	d_{11} Cm
1.			
2.			
3.			

CALCULATIONS:

Calculate the value of logarithmic decrement for different series resistances using the following formula:

$$\lambda = \frac{2.3026}{10} \log_{10} \frac{d_1}{d_{11}}$$

Operating Instructions for New Tech Type NTI SETUP - 425

RESULT:

1. Resistance of the given Ballistic Galvanometer $G = \dots\dots\dots$ Ohm.
2. The values of logarithmic decrements for different series resistance are given below :

- | | | |
|-------|------------------------------|-----------------------------|
| (i) | $R = 0\Omega$ | $\lambda = \dots\dots\dots$ |
| (ii) | $R = \dots\dots\dots \Omega$ | $\lambda = \dots\dots\dots$ |
| (iii) | $R = \dots\dots\dots \Omega$ | $\lambda = \dots\dots\dots$ |
| (iv) | $R = \dots\dots\dots \Omega$ | $\lambda = \dots\dots\dots$ |
| (v) | $R = \dots\dots\dots \Omega$ | $\lambda = \dots\dots\dots$ |

Thus the value of logarithmic decrement decreases/Increases with series resistance.

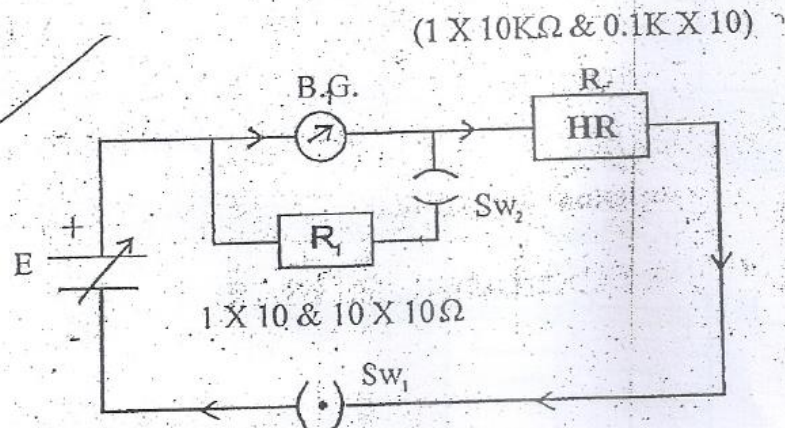


Fig. (1)

OPERATING INSTRUCTIONS FOR DETERMINATION OF STEFAN'S CONSTANT BY B B METHOD

1. OBJECT:

Determination of Stefan's constant using an incandescent lamp (Torch Bulb) and photo voltaic cell (B B Method).

2. APPARATUS:

The New Tech Type EM-122 Electronic Training Board consists of a regulated power supply to activate a torch bulb. Bulb is acting as a black body. Voltage and hence temperature of black body can be controlled by coarse and fine controls are provided on the panel of the board. Meters are provided to read voltage and current to the bulb on the panel. Bulb and solar cell are mounted on the top fixed optical bench (covered and provided with a peeping hole). High input impedance electronic micro ammeter is provided to read voltage generated accross the terminal of the solar cell with a zero setting provision if required. Setup is compact and handy, and is an integrated unit operative on 220 volts 50 Hz AC mains.

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✓ 3. THEORY:

Formula used to determine Stefan's constant by B B method is read as

$$\sigma = 2.43 \times 10^{-4} (V/T) \dots\dots\dots (1)$$

where $V = V_o + V_{oc}$

$V_o =$ is work function of material found from intercept of graph between V_{oc} and T.

$V_{oc} =$ Solar cell open circuit voltage corresponding to energy of the photons emitted by the black body.

Graph plotted between open circuit voltage V_{oc} of solar cell and the absolute temperature T of the black body is a straight line and its equation can be given by $V_{oc} = mT - V_o$, thus when this line is extrapolated it cut V_{oc} axis on negative side. The intercept thus obtained is V_o .

FINDING TEMPERATURE OF BLACK BODY:

Temperature of the black body is obtained from resistance measurement using Ohm's law. Circuit diagram shown in Fig. (1) is employed using relation $R_t = V_t/I_t$ (2)

Method is crude but the temperature range is so wide that these resistance measurements will be quite useful to get good estimates of the filament temperature T. Variation in filament resistance with temperature is given by $R_t = R_o(1 + \alpha t + \beta t^2 + \gamma t^3)$.

R_o is the resistance at 0°C will be so low that small

Operating Instructions for New Tech Type EM-122

error in resistance measurement would lead to large error in T. The draper point (The temperature at which filament of the bulb just starts showing a dull red glow) is 800°K or $t = 530^{\circ}\text{C}$ and trial shows that it is reproducible well within 20%.

Further measurement of draper point resistance R_d at draper temperature need no extra devices. Thus if V_d is the draper voltage, I_d is the draper point current then $R_d = V_d/I_d$ and experimentally it has been seen that R_o is related to R_d as $R_o = R_d/3.9$ where 3.9 is the slope of the line when $\log P$ (power radiated by the black body) is plotted against $\log T$ (temperature of black body).

For tungsten filament $\alpha = 5.21 \times 10^{-3}/^{\circ}\text{C}^2$,
 $\beta = 7.2 \times 10^{-7}/^{\circ}\text{C}$, and $\gamma = 6.0 \times 10^{-12}/^{\circ}\text{C}^3$.

Compute R_t/R_o for different t values i.e., $t = 100, 200, 400, 800, 1200, 1600, 1800, 2000, 2200$ and 2400°C .

Plot R_t/R_o against ' t ' or $T (= t + 270)$ and draw a smooth curve. This graph in turn helps to find temperature of the black body at any illumination of the bulb by calculating its resistance R_t using relation (2). Simultaneously measuring V_{oc} for different temperature of the black body, plot graph between V_{oc} and T , extrapolate the line so obtained; and measure intercept to get V_o . Add V_o to all V_{oc} values measured on electronic meter to get V . Find average V/T to calculate Stefan's constant using relation (1).

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4. PROCEDURE:

- (1) Keep coarse and fine control knobs at minimum position and switch on the setup.
- (2) Keep range selector on VA range. Now gradually increase voltage to the bulb by turning coarse control knob clock wise till the filament just shows a dull red glow (glow can be seen peeping through the hole provided on optical bench) measure V_d and I_d . Going to a bit higher illumination, reduce it till the glow just ceases. Measure V_d and I_d again. Repeat this process 2-3 times and find mean $R_d = V_d/I_d$. Also calculate $R_o = R_d/3.9$ and record in O.T. No. (1).
- (3) Compute R_t/R_o for different values of t and substituting values of α , β and γ . Record these computed data in O.T. No. (2). Plot graph between R_t/R_o and T .
- (4) Do short sockets of the electronic meter and set zero remove shorting of these sockets. To obtain $R_t = V_t/I_t$ over a wide range, going up till the filament glows a white bright light (take 5-6 readings of V_t , I_t and V_{oc} for different setting of temperature control knobs in suitable steps of voltage starting from just glow position of filament to very bright white). Note these observations in O.T. No. (3).
- (5) Calculate R_t/R_o (R_t obtained in step 4 divided by R_o obtained in step 2) and find corresponding temperature

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T from the graph plotted in step 3, note temperature T in O.T. No. (3).

- 6) Plot graph between V_{oc} and temperature T (data from Table 3) taking V_{oc} on Y axis and T on X axis. Extrapolate the line thus obtained, the intercept on the negative V_{oc} axis, measure V_o . Add V_o to all values of V_{oc} and find V. Divide V by T and find average value of V/T to calculate Stefan's constant using relation (1). Record these in O.T. No. (4).

6. OBSERVATIONS:

O.T. No. (1) for draper resistance measurement of filament :

Sr. No.	V_d (Volts)	I_d (Amp)	$R_d = V_d/I_d$ (Ohms)	Average R_d	$R_0 = R_d/3.9$
1.					
2.					
3.					

O.T. No. (2) for graph between R_t/R_0 (computed) against T :

$R_t/R_0 = 1 + \alpha t + \beta t^2 + \gamma t^3$					
Temperature $t^\circ\text{C}$	100	200	400		2400
$T = t^\circ\text{C} + 270$					

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O.T. No. (3) for graph between V_{oc} and temperature T :

For measuring V_{oc}

1 Division of $\mu A = \dots\dots\dots mV$

$= \dots\dots\dots V$

$V_{oc} = \text{Deflection of } \mu A \text{ in number of divisions} \times \text{value of one division of } \mu A \text{ in volt.}$

Sr. No.	Temperature of black body					Voltage across solar cell V_{oc} (Volts)
	V_t (Volts)	I_t (Amp)	$R_t = V_t/I_t$ (Ohms)	R_t/R_o	Temperature read from graph (T)	
1.						
2.						
3.						

O.T. No. (4) for average value of V/T :

Sr. No.	Temp. of black body T	V_{oc}	$V = V_o + V_{oc}$	V/T	Average V/T
1.					
2.					
3.					
4.					
5.					
6.					

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6. CALCULATIONS:

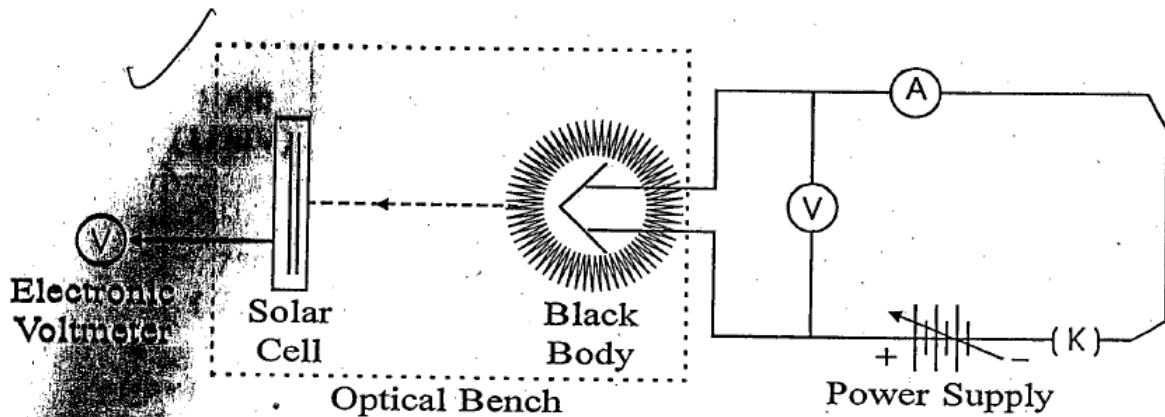
- (1) For measured value of R_0 from Table (1). Compute $R_t/R_0 = (1 + \alpha t + \beta t^2 + \gamma t^3)$ taking t values ranging from 100, 200, 400, 800 to 2400°C for given values of α, β, γ .
- (2) Calculate Stefan's constant using relation (1) for average V/T from observation Table (4).

7. RESULTS:

Value of Stefan's constant $\sigma = \dots\dots\dots \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$.

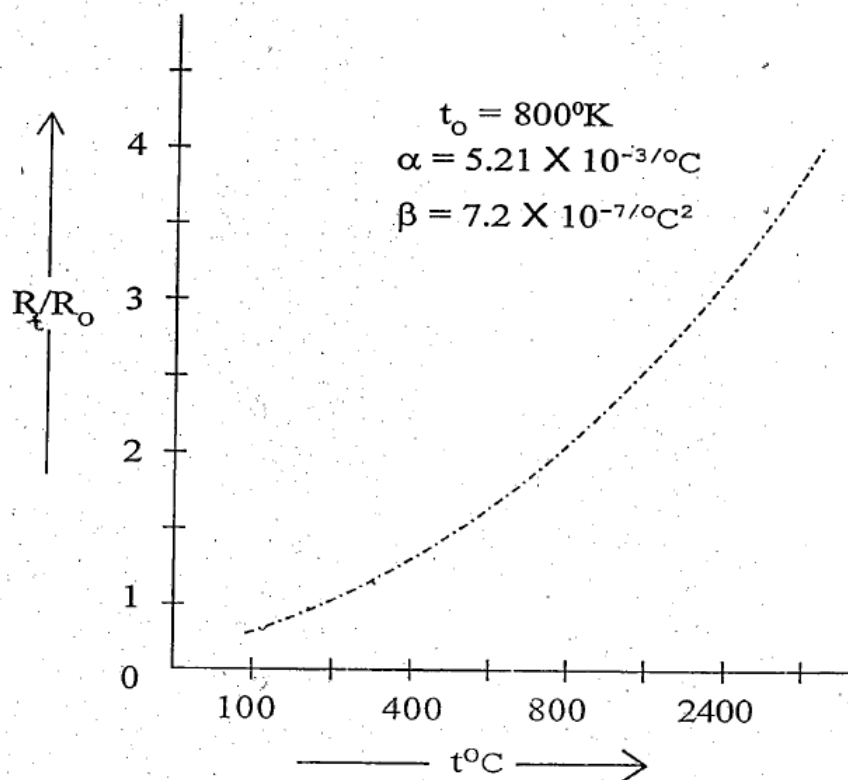
Standard value of Stefan's constant = $5.67 \times 10^{-8} \text{ W m}^{-2} \text{ K}^{-4}$.

Operating Instructions for New Tech Type EM-122



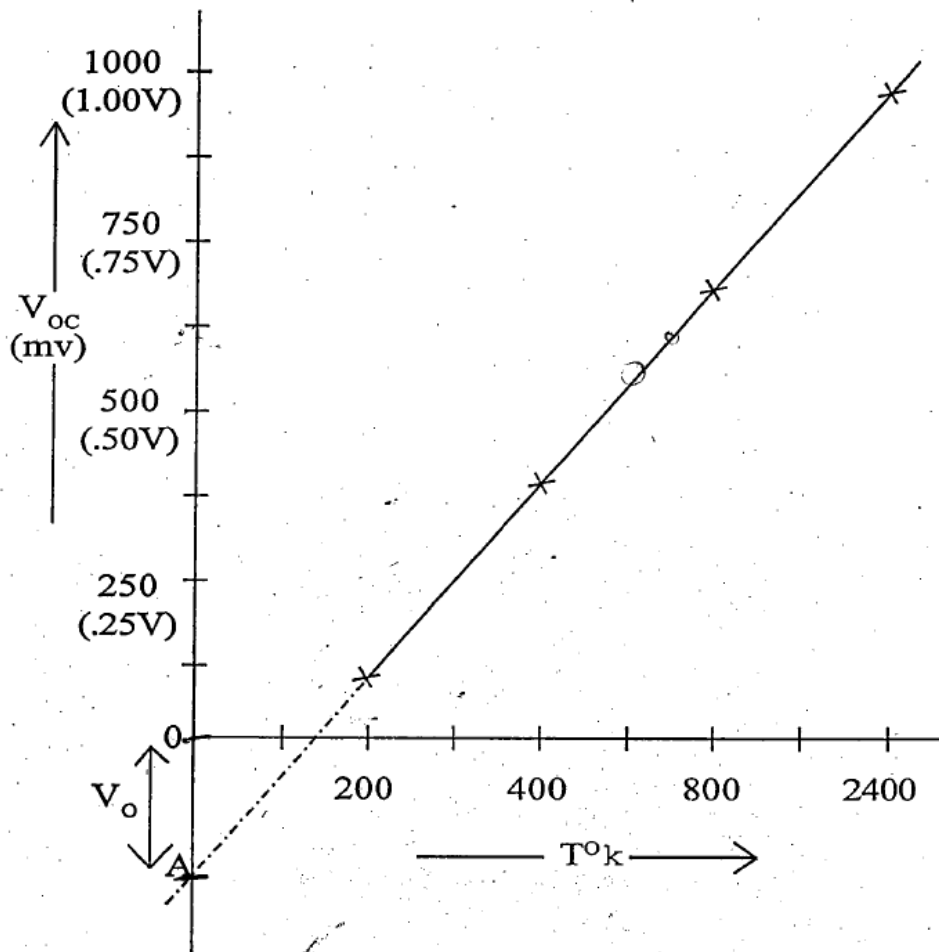
SCHEMATIC DIAGRAM

Fig. (1)



TYPICAL GRAPH BETWEEN R/R_0 AND TEMPERATURE $t^{\circ}C$.

Operating Instructions for New Tech Type EM-122



TYPICAL GRAPH BETWEEN
SOLAR CELL VOLTAGE V_{oc} & T

**OPERATING INSTRUCTIONS FOR EXPERIMENTAL
SET UP ON STUDY OF THERMO E.M.F. USING
SAND BATH**

OBJECT:

To determine the thermo E.M.F. of a copper iron thermo couple and then to draw a graph between the thermo E.M.F. generated and the temperature of the hot junction, keeping the temperature of the cold junction constant using potentiometer and sand bath.

APPARATUS:

The training board New Tech Type NTI – 432, Copper – Iron Thermocouple, stand for thermocouple, sand bath, Hot plate and Thermometer (0 – 360°C).

TRAINING BOARD NTI – 432:

As shown in Fig. (4) of panel diagram it consists of a potentiometer having wire of 50cm length and 19 coils of same length. In the main circuit an IC regulated power supply, switch and a wire wound pot used as rheostat are provided on the board. In secondary circuit a standard cell – Daniel cell, a resistance of 1080Ω, two way switch, two terminals for connecting the thermocouple and a jockey are provided. To show null point a sensitive galvanometer is fixed on the board. A two way switch is also provided to select standard cell or thermocouple in the secondary circuit. Besides these a mains switch, fuse and led are provided on the board.

COPPER IRON THERMOCOUPLE:

A copper – iron Thermo Couple consists of an pair of copper and iron wires. Two ends of iron wire are connected to copper wires. Thus two junctions are made as shown in Fig (1)

Operating Instructions for New Tech Type NTI - 432

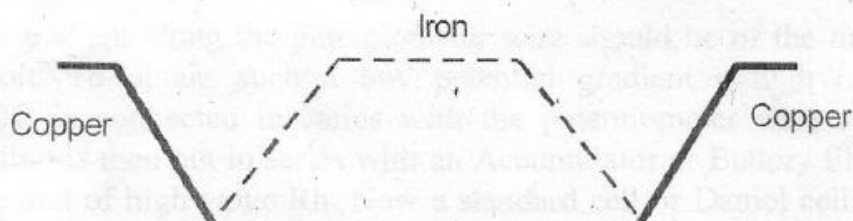


Fig (1) Copper – Iron Thermo Couple

The free ends of the copper wires are connected to a circuit containing a galvanometer. One junction of the thermocouple is immersed in a cold bath made by ice in a funnel while the other end is put in a hot bath prepared by taking sand in a sand bath placed on a hot plate. One thermometer is placed in sand bath by the side of hot junction of the couple. When temperature difference is set up between the two junctions, current begins to flow from iron to copper at the hot junction and the galvanometer gives deflection. Fig(2).

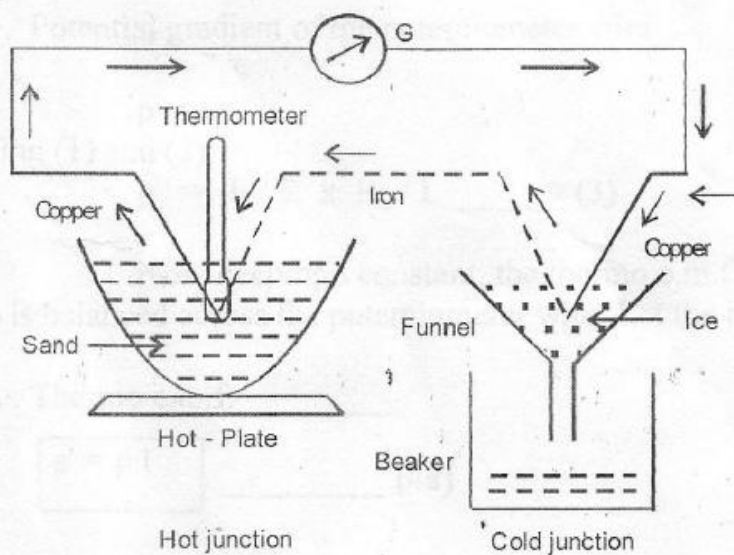


Fig. (2)

THEORY:

The circuit diagram has been shown in Fig (3). The connections are self explanatory. To measure fairly low thermo e.m.f. generated due to temperature difference between the two junctions by potentiometer, the

Operating Instructions for New Tech Type NTI - 432

potential gradient along the potentiometer wire should be of the order of a micro volt. To obtain such a low potential gradient a high resistance $R = 1080\Omega$ is connected in series with the potentiometer wire AB. This combination is then put in series with an Accumulator or Battery Eliminator B_1 , a rheostat of high value R_h . Now a standard cell or Daniel cell e.m.f. = 1.08V is balanced across the two terminals of the resistance R by adjusting R_h . If by adjusting R_h balance point is not obtained then some high resistance R_1 may be connected in series with R_h to obtain balance point.

Let i be the current flowing through the potentiometer circuit, then we have

$$E = i R \quad (1)$$

Where $E (= 1.08V)$ is the e.m.f. of standard cell.

If total length of potentiometer wire is L and its total resistance is R_L . Then Resistance per unit length of the potentiometer wire is

$$r = R_L / L \quad (2)$$

\therefore Potential gradient of the potentiometer wire

$$\rho = i r$$

using (1) and (2)

$$\rho = E / R \times R_L / L \quad (3)$$

Now keeping i constant, the thermo e.m.f. e generated in the couple is balanced across the potentiometer wire. Let the balancing length be l .

\therefore Thermo e.m.f. _____

$$e = \rho l \quad (4a)$$

Or

$$e = \frac{E}{R} \times \frac{R_L}{L} \times l \quad (4b)$$

Operating Instructions for New Tech Type NTI - 432

Putting the values on R.H.S. the value the thermo e.m.f. is calculated. The value of e is determined at different temperatures of hot junction. Knowing e at various temperatures, a graph is plotted in between temperature difference and thermo e.m.f. generated.

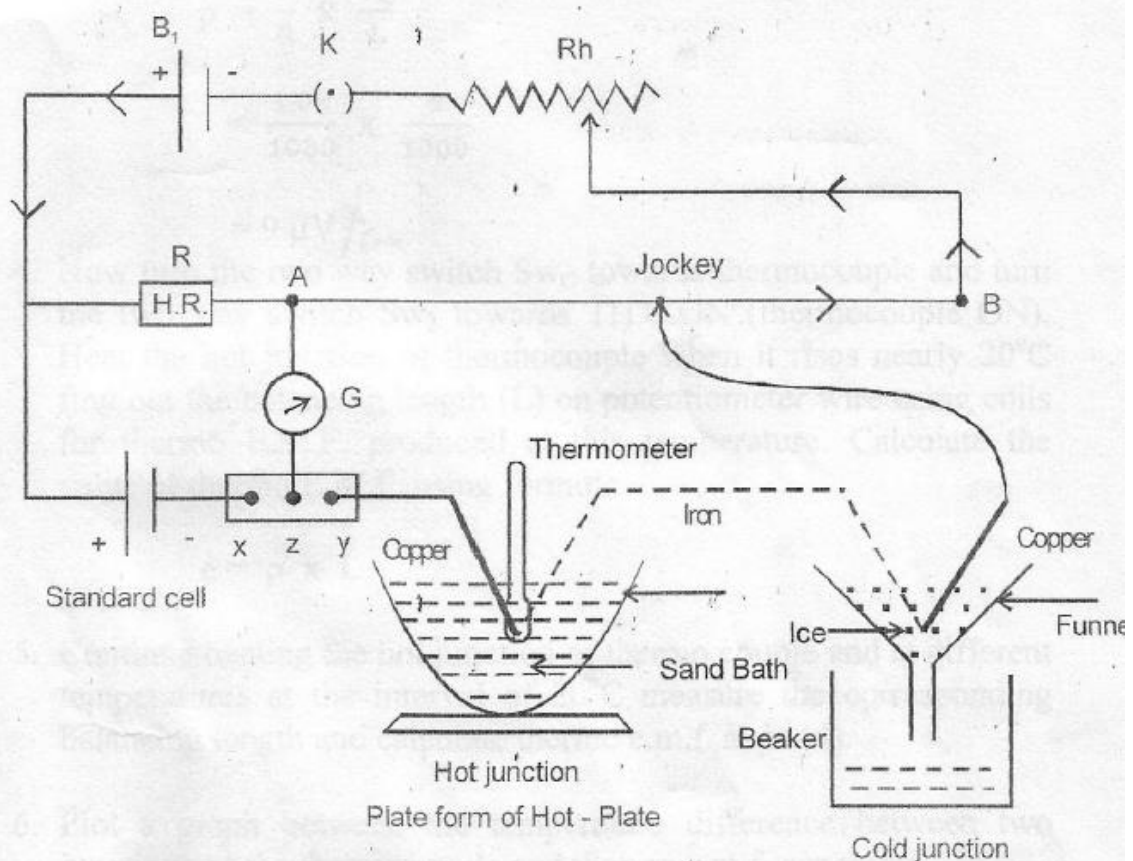


Fig (3) Circuit Diagram

PROCEDURE:

1. Connect the training board to AC supply. Switch it ON. LED will glow indicating that the apparatus is ready for use.
2. Keep the two way switch Sw_G towards standard cell. Switch ON the switch Sw_1 of main circuit. Keep the two way switch Sw_2 of secondary circuit towards S.C.ON (standard cell ON).

Operating Instructions for New Tech Type NTI - 432

3. Adjust rheostat of main circuit show that balance point is obtained. i.e. galvanometer should indicate zero deflection. Calculate potential gradient of the potentiometer wire using formula –

$$\begin{aligned}\rho &= \frac{E}{R} \times \frac{R_L}{L} \\ &= \frac{1.08}{1080} \times \frac{9}{1000} \\ &= 9 \mu\text{V} / \text{cm}\end{aligned}$$

4. Now turn the two way switch Sw_G towards thermocouple and turn the two way switch Sw_2 towards TH.C.ON (thermocouple ON). Heat the hot junction of thermocouple when it rises nearly 20°C find out the balancing length (L) on potentiometer wire using coils for thermo E.M.F. produced at this temperature. Calculate the value of thermo E.M.F. using formula –

$$e = \rho \times L$$

5. Continue heating the hot junction of thermo couple and at different temperatures at the interval of 20°C measure the corresponding balancing length and calculate thermo e.m.f. as in (4).
6. Plot a graph between the temperature difference between two junctions of the thermocouple and thermo e.m.f. generated.

OBSERVATIONS:

1. Resistance of Potentiometer wire (R_L) = 9 ohm.
2. length of Potentiometer wire L
(AB) = $19 \times 50 + 50 = 1000 \text{ Cm}$
3. E.M.F. of the standard Daniel cell
(E) = 1.08 volt

Operating Instructions for New Tech Type NTI - 432

O.T. For Thermo E.M.F. generated in Thermo Couple

S. No.	High Resistance R Ohm	Temperature		Balancing Length of the potentiometer wire when temperature is		Mean Balancing Length $L = \frac{L_1 + L_2}{2}$ Cm	Thermo e.m.f. generated in μV $e = \rho L$
		Hot Junction $^{\circ}\text{C}$ (t_2)	Cold JN $^{\circ}\text{C}$ (t_1)	Increasing Cm L_1	Decreasing Cm L_2		

(Balancing length = Number of coils x 50 + Balancing length of wire)
= Cm.

CALCULATIONS: Potential Gradient :

$$\begin{aligned} \rho &= \frac{E}{R} \times \frac{R_L}{L} \\ &= \frac{1.08}{1080} \times \frac{9}{1000} \\ &= 9 \mu\text{V} \end{aligned}$$

Thermo e.m.f.

$$e = \rho L$$

Plot graph between temperature difference between two junctions and the thermo e.m.f. generated.

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RESULT:

The graph is in the form of a parabola. The temperature at which the thermo e.m.f. is maximum i.e. The neutral temperature of Copper – Iron thermocouple = ----- °C

PRECAUTIONS:

1. Potential gradient should be of the order of micro volt per centimetre.
2. During determination of balancing length pencil jockey should not be slid on potentiometer wire but after lifting from one position it should be touched at next position.
3. Very high sensitive galvanometer should be used.
4. While determining balance points the current i in the potentiometer wire should remain constant, otherwise the calibration will go wrong.

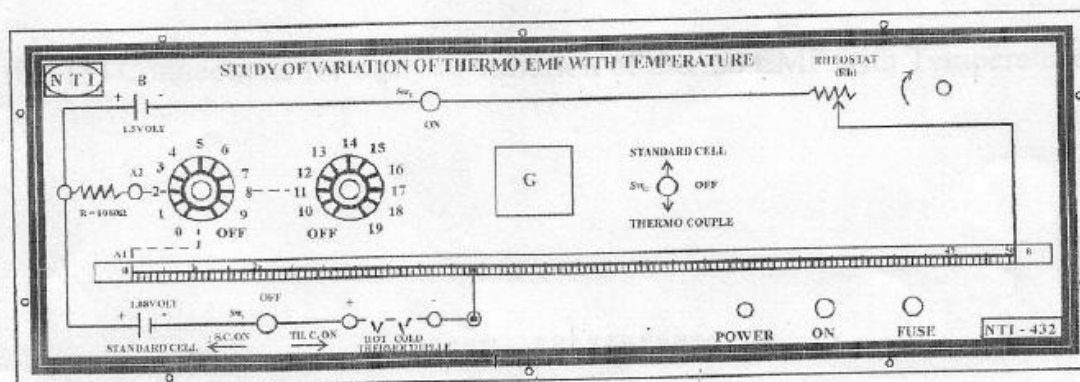


Fig. (4) Panel Diagram of training board NTI – 432

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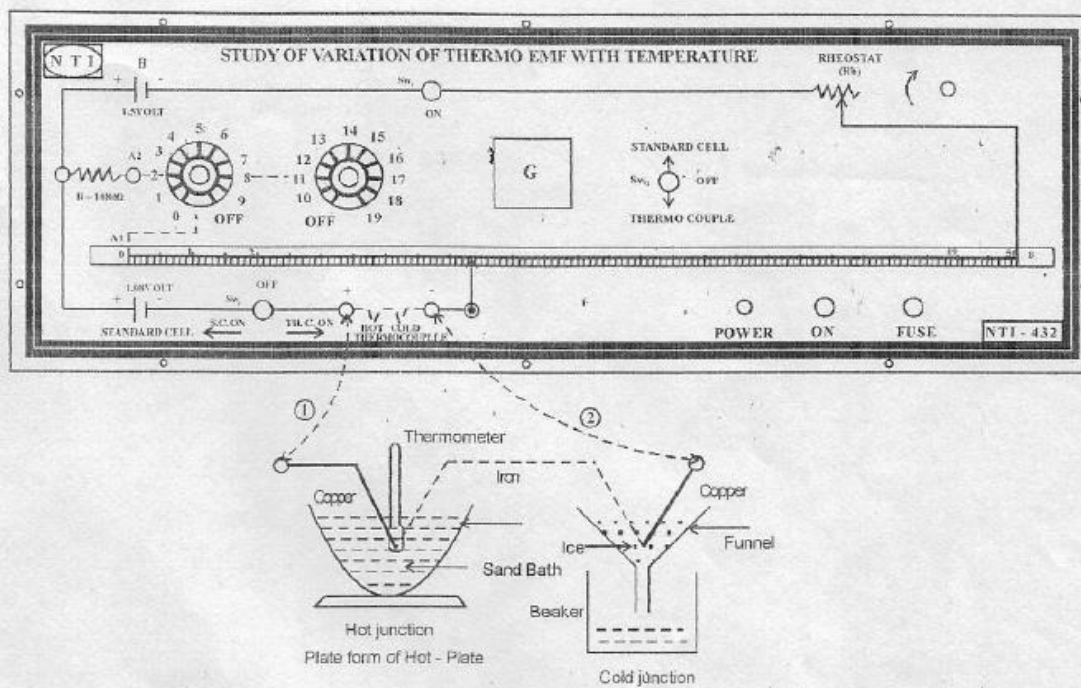


Fig. (5) Connections for study of variation of thermo EMF with Temperature

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Title of Course: Basic Electrical & Electronics Engineering-II Lab

Course Code: ES291

L-T-P scheme: 0-0-3

Course Credit: 2

Basic Electronics Engineering-II Lab:

Objectives:

1. Impart understanding of working principles and applications of semiconductor devices in the design of electronic circuits.
2. Introduce basic applications like rectifiers, amplifiers and other signal conditioning circuits with emphasis on practical design considerations.
3. Provide basic understanding of digital circuits and principles of logic design.
4. To enhance the understanding of the topics in the curriculum, specific activities have been designed as conceptual and hand sonaid.

Learning Outcomes: On successful completion of this course, the students will be able to:

1. Analyze and appreciate the working of electronic circuits in volving applications of diodes and transistors.
2. Comprehend working of amplifiers.
3. Design simple analog circuits using general purpose op-amp IC741.
4. Design digital circuits to meet a given specification using digital ICs
5. Develop simple projects based on the different devices studied in this course.

Course Contents:

Exercises that must be done in this course are listed below:

1. Study of characteristics curves of FET.
2. To determine input-offset voltage, input bias current and Slew rate of OPAMPs
3. To study the operation of inverting amplifier.
4. To study the operation of non-inverting amplifier.
5. To construct logic gates NOT, AND, OR, EX-OR, EX-NOR of basic gates using NAND gate and verify their truth tables.

Text Book:

1. Melvin: Electronic Principle.S
2. Schilling & Belove: Electronics Circuits.
3. Millman & Grabal: Microelectronics

Recommended Component Requirements:

1. Resistors , Capacitors ,Transistors ,Inductors ,Bread board and jumper wires
2. Input Output Device Function Generator CRO Probes.
3. Power Supply Proper Requirement.

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EXPERIMENT-1

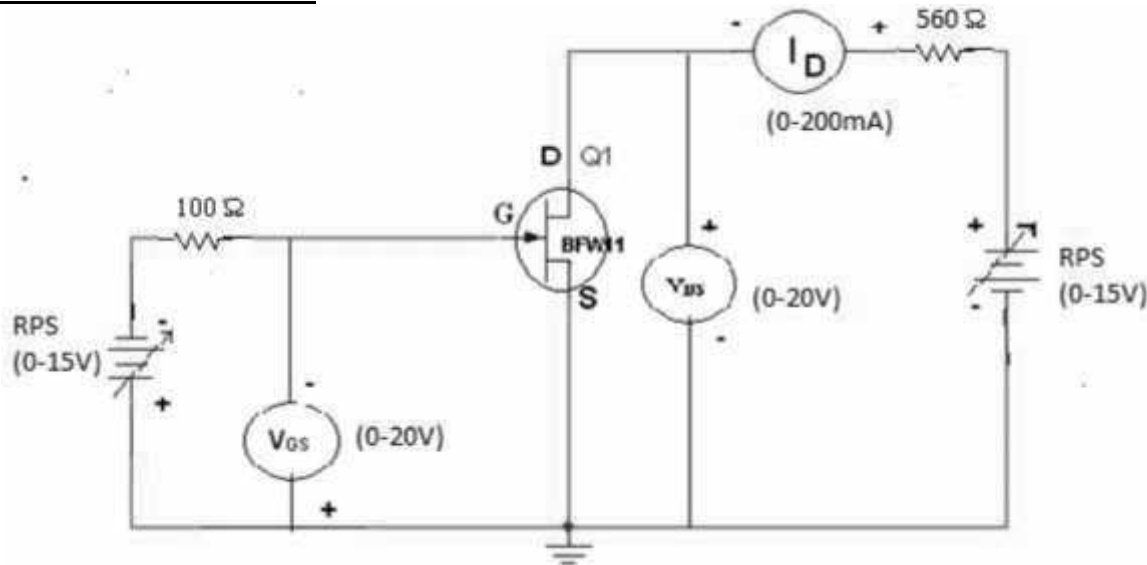
AIM: Study of characteristics curves of FET.

THEORY:

A FET is a three terminal device, having the characteristics of high input impedance and less noise, the Gate to Source junction of the FET is always reverse biased. In response to small applied voltage from drain to source, the n-type bar acts as sample resistor, and the drain current increases linearly with V_{DS} . With increase in I_D the ohmic voltage drop between the source and the channel region reverse biases the junction and the conducting position of the channel begins to remain constant. The V_{DS} at this instant is called “pinch off voltage”. If the gate to source voltage (V_{GS}) is applied in the direction to provide additional reverse bias, the pinch off voltage will be decreased. In amplifier application, the FET is always used in the region beyond the pinch-off.

$$I_D = I_{DSS} \left[1 - \frac{V_{GS}}{V_P} \right]^2$$

CIRCUIT DIAGRAM:



PROCEDURE:

1. All the connections are made as per the circuit diagram.
2. To plot the drain characteristics, keep V_{GS} constant at 0V.
3. Vary the V_{DD} and observe the values of V_{DS} and I_D .
4. Repeat the above steps 2, 3 for different values of V_{GS} at 0.1V and 0.2V.
5. All the readings are tabulated.
6. To plot the transfer characteristics, keep V_{DS} constant at 1V.
7. Vary V_{GG} and observe the values of V_{GS} and I_D .
8. Repeat steps 6 and 7 for different values of V_{DS} at 1.5 V and 2V.
9. The readings are tabulated.

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OBSERVATIONS:

DRAIN CHARACTERISTICS:

	$V_{GS}=0V$		$V_{GS}=-1V$		$V_{GS}=-2V$	
S.NO	$V_{DS}(V)$	$I_D(mA)$	$V_{DS}(V)$	$I_D(mA)$	$V_{DS}(V)$	$I_D(mA)$

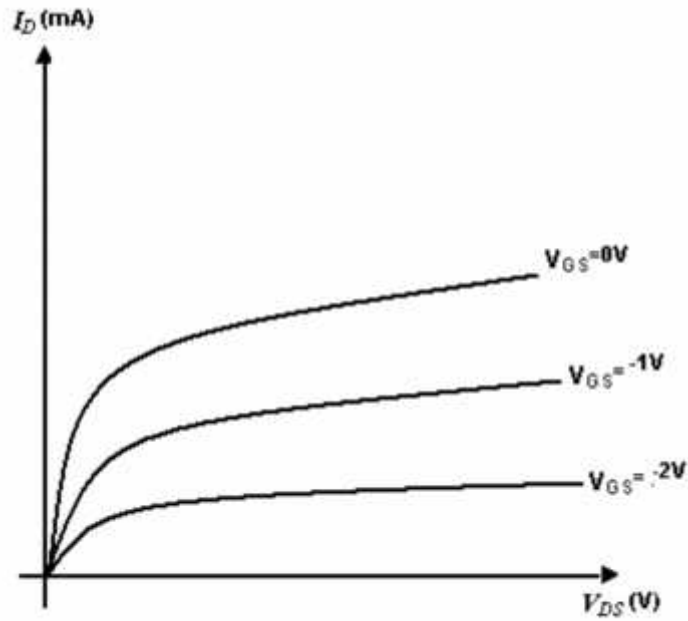
TRANSFER CHARACTERISTICS

	$V_{DS}=0.5V$		$V_{DS}=1V$		$V_{DS}=1.5V$	
S.NO	$V_{GS}(V)$	$I_D(mA)$	$V_{GS}(V)$	$I_D(mA)$	$V_{GS}(V)$	$I_D(mA)$

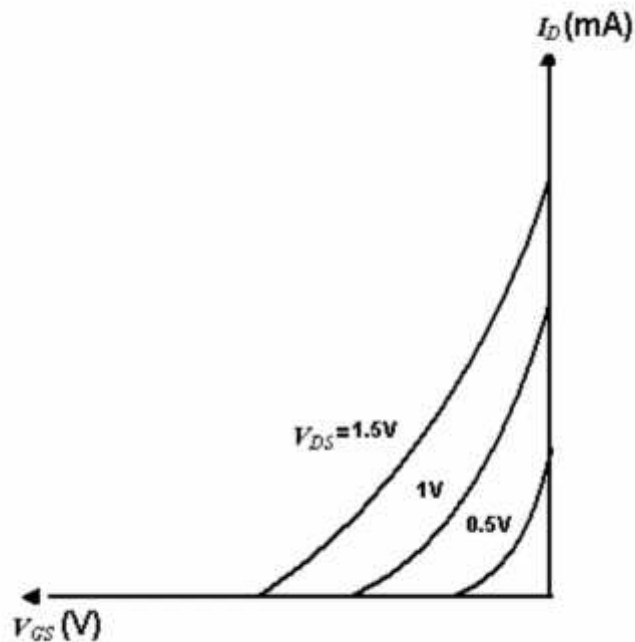
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MODEL GRAPH:

DRAIN CHARACTERISTICS:



TRANSFER CHARACTERISTICS:



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EXPERIMENT-2

AIM: To determine input-offset voltage, input bias current and Slew rate of OPAMPs.

APPARATUS REQUIRED:

1. Op – Amp IC 741
2. Dual Power Supply 15V,
3. Resistors
4. Capacitors
5. Function Generator
6. Cathode Ray Oscilloscope
7. Multimeter
8. Breadboard and Connecting Wires

THEORY: An ideal op-amp draws no current from the source and its response is also independent of temperature. However, a real op-amp does not work this way. Current is taken from the source into op-amp inputs. Also the two inputs respond differently to current and voltage due to mismatch in transistors. A real op-amp also shifts its operation with temperature. These non-ideal characteristics are: 1. Input bias current 2. Input offset current 3. Input offset voltage 4. Thermal drift 5. Slew rate 6. input and output voltage ranges

Input offset voltage

Ideally, the output voltage should be zero when the voltage between the inverting and noninverting inputs is zero. In reality, the output voltage may not be zero with zero input voltage. This is due to un-avoidable imbalances, mismatches, tolerances, and so on inside the op-amp. In order to make the output voltage zero, we have to apply a small voltage at the input terminals to make output voltage zero. This voltage is called *input offset voltage* .i.e., input offset voltage is the voltage required to be applied at the input for making output voltage to zero volts.

Input bias current

The op-amp's input is a differential amplifier, which may be made of. BJT or FET. In either case the input transistors must be biased into this linear region by supplying currents into the bases. In an ideal op-amp, no current is drawn from the input terminals. However, practically, input terminals conduct a small value of dc current to bias the input transistors when base currents flow through external resistances, they produce a small differential input voltage or unbalance; this represents a false input signal. When amplified, this small input unbalance produces an offset in the output voltage. The input bias current shown on data sheets is the average value of base currents entering into the terminals of an op-amp.

$$I_B = \frac{(I_B^+ + I_B^-)}{2}$$

(1)

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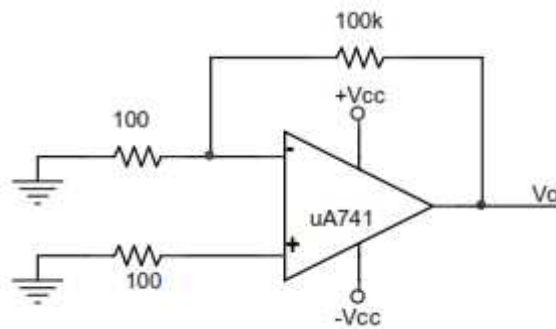
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Slew rate

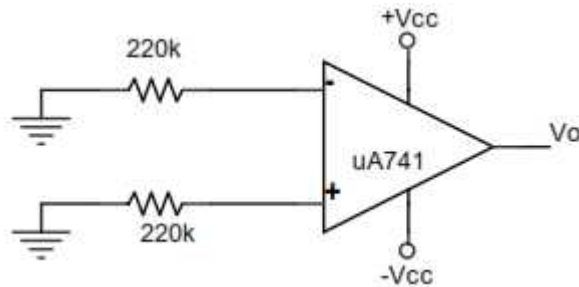
Among all specifications affecting the ac operation of the op-amp, slew rate is the most important because it places a severe limit on a large signals operation. *Slew rate is defined as the maximum rate at which the output voltage can change.* The 741 op-amp has a typical slew rate of 0.5 volts per microsecond ($V/\mu s$). This is the ultimate speed of a typical 741; its output voltage can change no faster than $0.5V/\mu s$. If we drive a 741 with large step input, it takes $20\mu s$ ($0.5 V/\mu s \times 10V$) for the output voltage to change from 0 to 10V.

CIRCUIT DIAGRAM

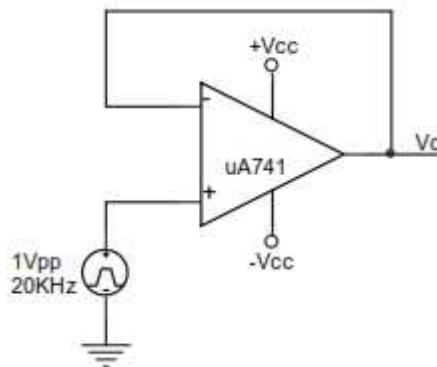
Input offset voltage



Input bias current



Slew rate



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OBSERVATION TABLE:

Input offset voltage

V_{out}	$V_{in} = V_{out}/1000$

Input bias current

DC voltage at the non-inverting terminal V^+	DC voltage at the inverting terminal V^-	$I_B^+ = \frac{V^+}{220K}$	$I_B^- = \frac{V^-}{220K}$	Input bias current $I_B = \frac{(I_B^+ + I_B^-)}{2}$

Slew rate

ΔV	ΔT	$SR = \Delta V/\Delta T$

RESULT:

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EXPERIMENT-3

AIM: To study the operation of inverting amplifier.

APPARATUS REQUIRED:

9. Op – Amp IC 741
10. Dual Power Supply 15V,
11. Resistors
12. Capacitors
13. Function Generator
14. Cathode Ray Oscilloscope
15. Multimeter
16. Breadboard and Connecting Wires

THEORY:

This is the most widely used of all the Op-amp circuits. The output V_0 is fed back to the inverting input through the $R_f - R_{in}$ network as shown in figure where R_f is the feedback resistor. The input signal V_i is applied to the inverting input terminal through R_{in} and non- inverting input terminal of Op-amp is grounded. The output V_0 is given by

$$V_0 = V_i (-R_f / R_{in})$$

Where, the gain of amplifier is $- R_f / R_{in}$

The negative sign indicates a phase-shift of 180 degrees between V_i and V_0 . The effective input impedance is R_i . An inverting amplifier uses negative feedback to invert and amplify a voltage. The R_{in}, R_f resistor network allows some of the output signal to be returned to the input. Since the output is 180° out of phase, this amount is effectively subtracted from the input, thereby reducing the input into the operational amplifier. This reduces the overall gain of the amplifier and is dubbed negative feedback.

CIRCUIT DIAGRAM:

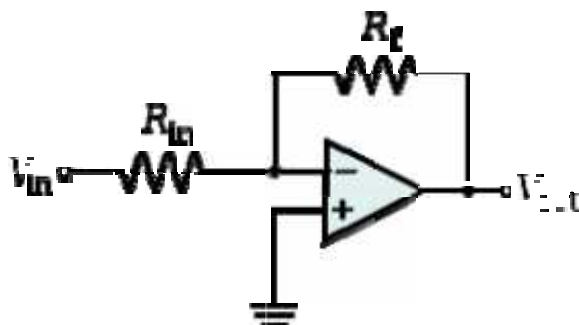


Fig. 1: Inverting amplifier

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OBSERVATION TABLE:

V_i =-----

R_{in} =-----

S.No	R_f	Observed V_0	Calculated V_0 $V_0 = V_i (-R_f / R_{in})$

MODEL GRAPH:

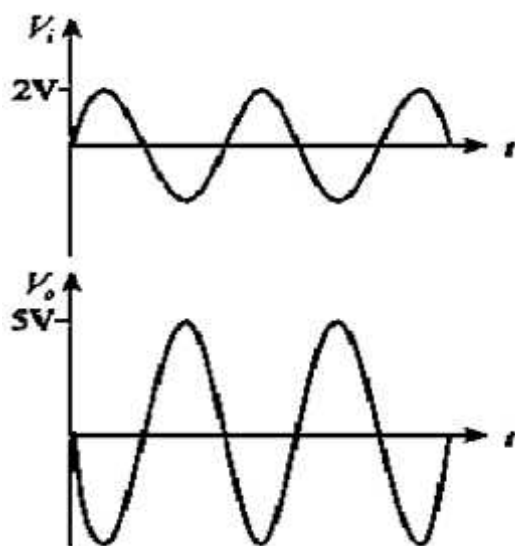


Fig. 2: Output of inverting amplifier

PROCEDURE:

1. Make connections as given in fig 1 for inverting amplifiers respectively.
2. Give sinewave input of V_i volts using function generator with the frequency of 1KHZ.
3. The output voltage V_0 observed on a CRO. A dual channel CRO to be used to see V_i & V_o .
4. Vary R_f and measure the corresponding V_0 and observe the phase of V_0 with respect to V_i .
5. Tabulate the readings and verify with theoretical values.

RESULT:

The linear applications of 741 op amp were studied experimental

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EXPERIMENT-4

AIM: To study the operation of non-inverting amplifier.

APPARATUS REQUIRED:

1. Op – Amp IC 741
2. Dual Power Supply 15V,
3. Resistors
4. Capacitors
5. Function Generator
6. Cathode Ray Oscilloscope
7. Multimeter
8. Breadboard and Connecting Wires

THEORY:

The circuit diagram of non – inverting amplifier is shown in figure. Here, the signal is applied to the non – inverting input terminal and feedback is given to inverting terminal. The circuit amplifies the input signal without inverting it. The output V_{out} is given by

$$V_0 = (1 + \frac{R_f}{R_i}) V_i$$

CIRCUIT DIAGRAM:

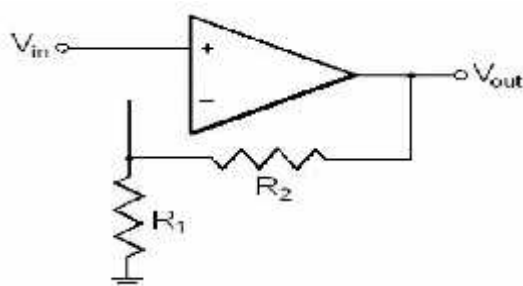


Fig. 1: Non-inverting amplifier

OBSERVATION TABLE:

V_i = -----

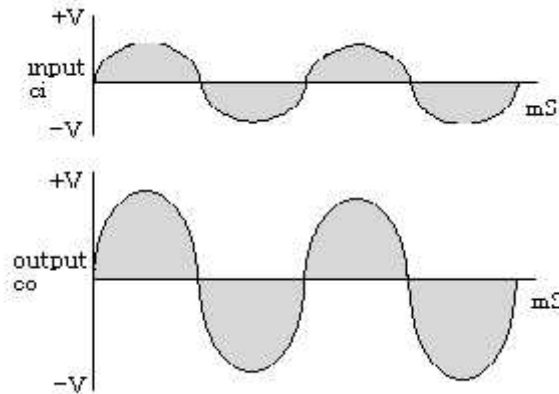
R_{in} = -----

S.No	R_f	Observed V_0	Calculated V_0 $V_0 = V_i (-R_f / R_{in})$

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MODEL GRAPH:



PROCEDURE:

Inverting & Non – inverting amplifier

1. Make connections as given in fig 1 non-inverting amplifiers respectively.
2. Give sinewave input of V_i volts using AFO with the frequency of 1KHZ.
3. The output voltage V_o observed on a CRO. A dual channel CRO to be used to see V_i & V_o .
4. Vary R_f and measure the corresponding V_o and observe the phase of V_o with respect to V_o .
5. Tabulate the readings and verify with theoretical values.

RESULT:

The linear applications of 741 op amp were studied experimentally.

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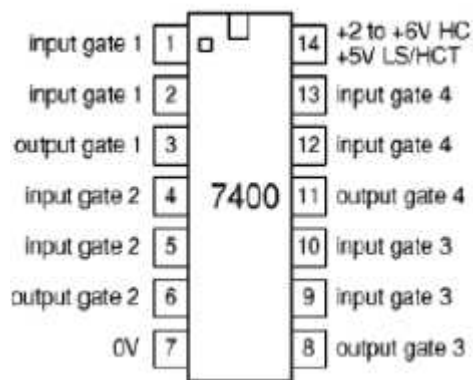
EXPERIMENT-5

AIM: To construct logic gates NOT, AND, OR, EX-OR, EX-NOR of basic gates using NAND gate and verify their truth tables.

Apparatus Required: Bread board, patch cords, IC 7400.

Pin Diagram:

IC 7400 NAND gate



Circuit Diagrams

Not gate



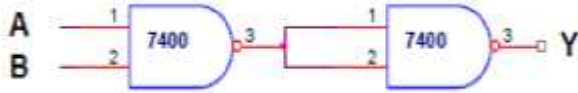
Truth Table

INPUT A	OUTPUT Y
0	1
1	0

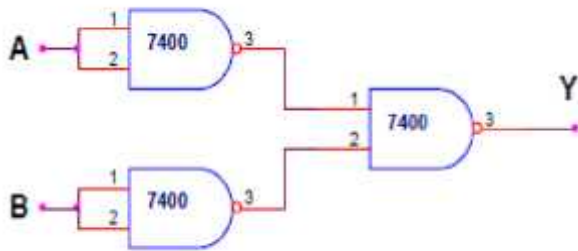
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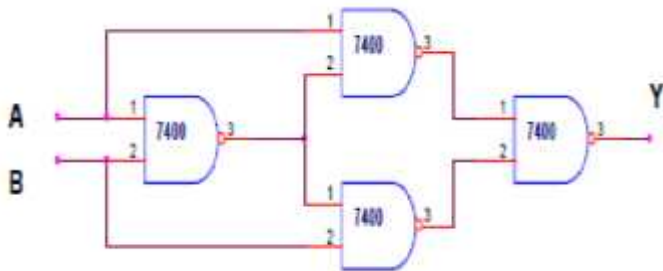
AND gate



OR gate



Ex-OR gate



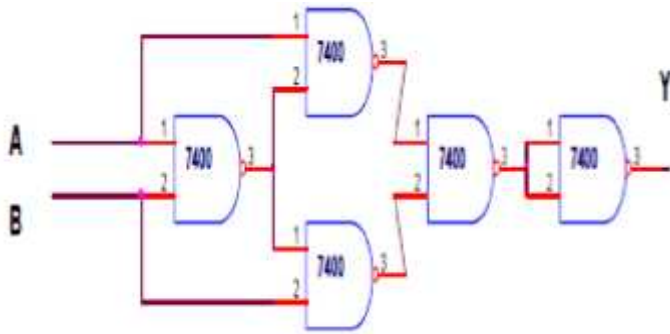
INPUT		OUTPUT Y
A	B	
0	0	0
0	1	0
1	0	0
1	1	1

INPUT		OUTPUT Y
A	B	
0	0	0
0	1	1
1	0	1
1	1	0

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Ex-NOR gate



INPUT		OUTPUT Y
A	B	
0	0	1
0	1	0
1	0	0
1	1	1

Procedure:

1. Connect the logic gates as shown in the diagrams using IC 7400 NAND gate.
2. Feed the logic signals 0 or 1 from the logic input switches in different combinations at the inputs A & B.
3. Monitor the output using logic output LED indicators.
4. Repeat steps 1 to 3 for NOT, AND, OR, EX – OR & EX-NOR operations and compare the outputs with the truth tables.

Precautions:

1. All the connections should be made properly.
2. IC should not be reversed.

Result: Different logic gates are constructed using NAND gates and their truth tables are verified.

Basic Electrical Engineering-II Lab:

Objectives:

1. Observe the speed variation of the DC motor by the resistance of the armature and field.
2. Verify the open circuit and short circuit results and got the idea about the core loss and copper loss of the single phase transformer
3. Verify the maximum power transfer theorem results Theoretically.

Learning Outcomes: By doing this practical students will gain the knowledge about the different parts of the DC machine and single phase transformer. Upon the completion of this practical course, the student will be able to:

- Get a clear idea about the different parts of the DC machine by seeing the cut section model of the machine.
- Understand the speed variation of the motor by varying the different resistance of the motor.
- Understand the proper way of calculating the core loss and copper loss of a Single Phase Transformer and also the other parameters..

Course Contents:

Exercises that must be done in this course are listed below:

Experiment No.1: Verification of Maximum power Transfer Theorem in breadboard

Experiment No. 2: To perform open circuit test on single phase transformer

Experiment No. 3: To perform short circuit test on single phase transformer

Experiment No. 4: Speed Control of DC Motor using armature resistance control

Experiment No. 5: Speed Control of DC Motor using field resistance control

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Text Books:

1. Basic Electrical Engineering -Abhijit Chakrabarti, Sudipta Nath,Chandan Kumar Chanda

References:

1. Basic Electrical Engineering(vol2)-B.L.Thereja
2. Basic Electrical engineering, D.P Kothari & I.J Nagrath, TMH, Second Edition
3. Hughes Electrical & Electronics Technology, 8/e, Hughes, Pearson Education.

EXPERIMENT NO: 01

TITLE: Verification of Maximum Power Transfer Theorem in breadboard

AIM: To Verify the Maximum Power Transfer Theorem in breadboard

APPARATUS REQUIRED:-

- (i) Bread Board
- (ii) Connecting Wire
- (iii) Different values of resistances
- (iv) A Dc power Source

THEORY:

This theorem is applicable for analyzing communication networks. According to this theorem "A resistive load will draw the maximum power from a network when the load resistance is equal to the resistance of the network as viewed from its output terminals, with all energy sources removed leaving behind their internal resistances." If R_L is the load resistance connected across terminals a and b which consist of variable DC supply and internal resistance is R_S , then according to this theorem, the load resistance will draw maximum power when it is equal to R_S i.e. $R_L = R_S$.

And the maximum power drawn= $V_{oc}^2 / 4 R_L$

Where, V_{oc} is the open circuit voltage at the terminals from which R_L is disconnected.

The variable resistor taken should be larger than fixed resistor. Then only power can be calculated.

CIRCUIT DIAGRAM:

Draw the circuit diagram as per the resistance and circuit are given in the lab.

CALCULATIONS:

Calculate the theoretical data's of the given circuit

OBSERVATION TABLE:

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S.No	Load Resistance(R_L)	I_L (Load Current)	Power($P=I_L^2 \cdot R_L$)

RESULT:

Plot a graph between load resistance and power and observe that the power will be maximum when (Load resistance= Internal Resistance)

DISCUSSION:

EXPERIMENT NO: 02

TITLE: Perform open circuit test on single phase transformer

AIM: To Perform open circuit test on single phase transformer

APPARATUS REQUIRED:-

- (i) Multi Meter
- (ii) Connecting Wire
- (iii) Open circuit test panel
- (iv) A single phase Transformer
- (v) A LPF Wattmeter

THEORY:

The purpose of the **Open Ckt. Test** is to determine no load loss or core loss and no load I_0 which is helpful in finding X_0 and R_0 . One winding of the transformer usually high voltage winding is left open and the other is connected to its supply of normal voltage and frequency. A wattmeter (W), Voltmeter (V) and ammeter (A) are connected in the low voltage winding, i.e., primary winding in the present case. With normal voltage applied to the primary, normal flux will be setup in the core, hence normal iron losses will occur which are recorded by the wattmeter. As in the primary no load current I_0 is small, Cu loss is negligibly small in primary and nil in secondary. Hence, the wattmeter reading represents practically the core loss under no load condition.

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CIRCUIT DIAGRAM:

OBSERVATION TABLE:

V_1 = Supply Voltage

I_0 = No Load Current measure by the ammeter

W = Core loss measure by the LPF Wattmeter

V_1	I_0	W	$\cos \phi$	X_0	R_0

CALCULATIONS:-

$$W = V_1 I_0 \cos \phi$$

$$\text{Therefore, } X_0 = V_1 / I_u, R_0 = V_1 / I_w$$

$$\text{Where } I_w = I_0 \cos \phi, I_u = I_0 \sin \phi$$

RESULT:

The Iron loss is obtained toW

DISCUSSION:

EXPERIMENT NO: 03

TITLE: Perform Short circuit test on single phase transformer

AIM: To Perform Short circuit test on single phase transformer

APPARATUS REQUIRED:-

- (i) Multi Meter
- (ii) Connecting Wire
- (iii) Open circuit test panel
- (iv) A single phase Transformer
- (v) A Wattmeter

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THEORY:

For **short circuit test**, one winding usually the low voltage winding, is short- circuited by a thick conductor (or through an ammeter which may serve the additional purpose of indicating rated load current).

A low voltage (usually 5 to 10% of normal primary voltage) at correct frequency is applied to the primary and is gradually and cautiously increased till full- load current is flowing both in primary and secondary (as indicated by the respective ammeters).

Since, in this test, the applied voltage is a small percentage of the normal voltage, the mutual flux ϕ produced is also a small percentage of its normal value. Hence, core losses are very small with the result that the wattmeter reading represents the full load Cu loss or $i^2 R$ loss for the whole transformer, i.e. sum of both primary and secondary Cu losses.. The equivalent impedance of the transformer under short- circuit condition, if V_{sc} is the voltage required to circulate rated load currents, is then given by $Z_{01} = V_{sc}/I_1$.

CIRCUIT DIAGRAM:

OBSERVATION TABLE:-

V=Supply Voltage

I= Short Circuit Current

W= Power measure by the Wattmeter

V	I	W	Z_{01}	X_{01}	R_{01}

CALCULATION

For Short Circuit Test:-

$$W = I^2 R_{01}$$

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$$Z_{01} = V / I$$

$$X_{01}^2 = (Z_{01}^2 - R_{01}^2)$$

RESULT:

The Cu loss is obtained toW

DISCUSSION:

EXPERIMENT NO: 04

TITLE: Speed Control of DC Motor using armature resistance control

AIM: To Control the speed of the DC Motor by varying the armature resistance

APPARATUS REQUIRED:-

- (i) MultiMeter
- (ii) Connecting Wire
- (iii) Speed Control test panel
- (iv) A DC Motor
- (v) A Rheostat
- (vi) A Tachometer

THEORY:

Any D.C. motor can be made to have smooth and effective control of speed over a wide range. The shunt motor runs at a speed defined by the expressions.

$$E_b = ZNP\Phi/60A \quad \text{and} \quad E_b = V - I_a R_a$$

i.e.,

$$N = (V - I_a R_a) / K\Phi, \quad \text{where } K = ZP/60A$$

Since $I_a R_a$ drop is negligible $N \propto V$ and $N \propto 1/\Phi$ or $N \propto 1/I_f$

Where N is the speed, V is applied voltage, I_a is the armature current, and R_a is the armature resistance and Φ is the field flux.

Armature resistance control:

Speed control is achieved by adding an external resistance in the armature circuit. This method is used where a fixed voltage is available. In this method, a high current rating rheostat is required.

Disadvantages:

- (a) Large amount of power is lost as heat in the rheostat. Hence, the efficiency is low.
- (b) Speed above the rated speed is not possible. The motor can be run from its rated speed to low speeds.

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CIRCUIT DIAGRAM:

OBSERVATION TABLE:

Sl.No.	Armature Voltage	Armature Resistance	Speed

RESULT:

Draw a graph between the armature voltage and speed of the motor and show that the speed decreases as the armature voltage increases.

DISCUSSION:

EXPERIMENT NO: 05

TITLE: Speed Control of DC Motor using field resistance control

AIM: To Control the speed of the DC Motor by varying the field resistance

APPARATUS REQUIRED:-

- (i) MultiMeter
- (ii) Connecting Wire
- (iii) Speed Control test panel
- (iv) A DC Motor
- (v) A Rheostat
- (vi) A Tachometer

THEORY:

Any D.C. motor can be made to have smooth and effective control of speed over a

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$E_b = ZNP\Phi/60A$ and $E_b = V - I_a R_a$
i.e.,

$N = (V - I_a R_a) / K\Phi$, where $K = ZP/60A$

Since $I_a R_a$ drop is negligible $N \propto V$ and $N \propto 1/\Phi$ or $N \propto 1/I_f$

Where N is the speed, V is applied voltage, I_a is the armature current, and R_a is the armature resistance and Φ is the field flux.

Field flux control:

Speed control by adjusting the air gap flux is achieved by means of adjusting the field current i.e., by adding an external resistance in the field circuit. The disadvantage of this method is that at low field flux, the armature current will be high for the same load. This method is used to run the motor above its rated speed only.

CIRCUIT DIAGRAM:

OBSERVATION TABLE:

Sl.No.	Field Resistance	Field current	Speed

RESULT:

Draw a graph between the Field current and speed of the motor and show that the speed increases as the field current increases.

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DISCUSSION:

Title of Course: Workshop Practice Lab

Course Code: ME291

L-T-P scheme: 1-0-3

Course Credit: 3

CARPENTRY

The carpentry deals with the constructional work such as making roof, floors, partitions etc. of a building by means of wood with the help of carpentry tools. The term joining (joinery) is used for connecting the wooden parts with the different joints such as making of doors, window, stairs etc.

TIMBER: The timber is the material used for carpentry and joinery work. it is the wood obtained from exogenous trees by cutting these trees after their full growth. The following technical terms relating to timber must be clearly understood:

1. Standing or stationary timber. It is the timber obtained from a living tree.
2. Rough timber. It is the timber obtained after felling a tree.
3. Converted timber. It is the timber, which has been sawn into various market sizes such as beams, battens, planks etc
4. Dressed timber. It is the timber, which has been sawn, placed and worked to the required condition.
5. Structural timber. It is the timber used in framing and load bearing structures.

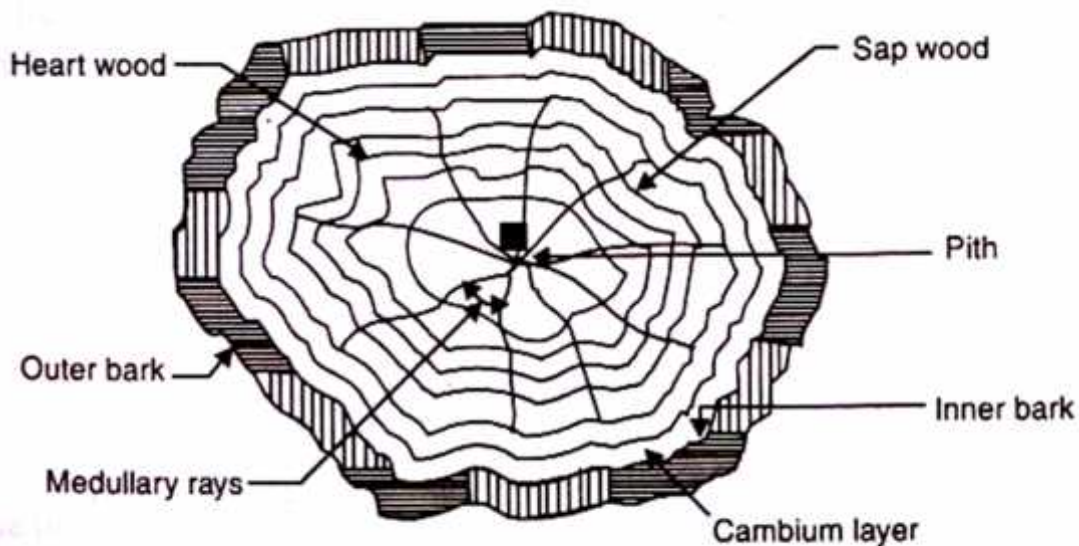


Fig. 9.1. Cross-section of an exogenous tree.

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ADVANTAGES OF TIMBER: The Timber has a number of advantages over other materials used in constructional work, the important of which are as follows:

1. It is easily available and can be quickly transported by simple means.
2. It is very easy to be worked on with tools.
3. It is lighter and stronger than most of the materials used in construction work.
4. It has less cost of construction.
5. It has a high salvage value.
6. It is quite suitable for soundproof construction.
7. It is a non-conductor of heat and electricity.
8. It responds very well to painting and polishing etc.

TYPES OF TIMBER:

It is mainly of two types, namely soft wood and hard wood

Soft wood: It is widely used for building construction work. These are resinous light in colors and weight, easy to be worked, have good tensile resistance but weak across the fibers.

Hard wood: It is widely used for doors, furniture, joinery etc. It is non-resinous, dark in colors and heavier in weight and have well tensile as well as shear resistance. So it is difficult to be worked.

SEASONING OF TIMBER: The seasoning of timber is the process of drying timber or removing moisture or sap, present in a freshly felled tree, under controlled conditions. The common methods are commonly used for seasoning of timber.

NATURAL SEASONING OR AIR SEASONING: In this method of seasoning, the tree, after felling is converted into logs, planks or battens. These are stacked in a dry place about 300 mm. above the floor level with longitudinal and cross pieces arranged one upon another. In order to prevent the effect of moisture on the wood from the bottom, a layer of cinder ash or sand is spread on the leveled platform before stacking the wood. The stacked wood is turned upside down periodically in order to accelerate the rate of drying. The wood gets dried due to the circulation of free air, which dries up the moisture.

This method of seasoning the wood is simple and cheap, but it is very slow and extends over years depending upon the type of wood and its cross section. The soft wood and their sections dry up easily whereas hardwood and thick sections take more time.

ARTIFICIAL SEASONING OR KILN SEASONING: This method of seasoning is the quickest of all the commonly used wood seasoning process. It keeps the moisture content under control. This process is carried out in a chamber under controlled temp. And humidity conditions with

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started at comparatively lower temp. And higher humidity. The conditions are changed as the timber dries. At the end of seasoning, the air is fairly hot and humidity is low. The required humidity level is maintained to avoid warping and cracking of wood. The drying of wood at uniform rate is well maintained by circulating air.

DEFECTS IN TIMBER: The defects in timber are of the following two types;

- . 1. Defects developed during the growth of a tree.
2. Defects occurring during conversion, seasoning or use
3. Defects due to the action of fungi and insects

NATURAL DEFECTS:

1. Knots: The impression left behind by the broken limbs or branches later appear as knots.
- 2 Shakes. When the tree is not cut even after attaining full maturity the cohesion

Amongst the wood grains is lost due to evaporation of jumps, moisture, resins and oils etc.

a>Heart shakes b> Star shakes c>Cup shakes

3. Irregular grains or twisted fibers: Such defects occur due to twisting of tree in different directions due to the blowing wind.
4. Rind or galls burls: These are the wounds created by the irregularly broken or cut branches at the place where they part off.

DEFECTS OCCURRING DURING CONVERSION, SEASONING AND USE

1. SHAKES: It occurs due to uneven shrinkage or due to falling of tree (heavy impact).
2. DISTORTION: If moisture content falls below 25%.

If seasoning is not uniform

If wood is sawn into thinner sections...Distortion takes place.

1. Case Hardening: It is also an effect of uneven drying during seasoning.
2. Honey- combing: It occurs due to the presence of hygroscopic substance in the outer tissues of the wood (in chemical seasoning).

QUALITIES OF GOOD TIMBER:

1. It should have straight fibers.
2. The wood obtained from near the pith is always better than the rest of the tree.

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3. It should be free from knots.
4. It should not possess natural defects.
5. On sawing, it should give a sweet smell.
6. It should not carry sudden change in colors; such a change is always a sign of disease.
7. It should have regular annual rings.
8. It should not clog the saw teeth during sawing.
9. It should be strong and heavy.
10. It should not split when are driven into it.
11. It should have high resistance to shock and stresses.
12. On striking, it should give a clear sound.
13. On planning, it should give silky luster and bright appearance.
14. It should have a dark colors.
15. It should be easily workable.
16. It should not warp or twist after seasoning.
17. It should respond well to polishing and painting.
18. It should have high resistance to fire.
19. It should be free from decay.

AUXILIARY MATERIALS USED IN CARPENTRY

1. Nails: Nails are used for reinforcing glued joints and fastening different parts.
2. Dowels: They are wooden nails, used for fastening different parts.
3. Screws: They are mainly used for fixing the metallic fittings like hinges, hasps, tower bolts etc.
4. Bolts and Nuts: They are used only where very heavy components are to be fastened together.
5. Glues: They are widely used for joining together the boards edge to edge to form a larger surface or face to face to increase thickness (wood work).

PRESERVATION OF TIMBER: In order to protect the timber from internal decay and attack of insects like white ants, some chemical preservation are used to increase the life of timber and to make the timber structures durable. A good preservative should have the following requirements:

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PRESERVATIVES: Tar oil, Water soluble chemical salts, Organic solvent chemicals

METHOD OF APPLICATION OF PRESERVATIVES:

1. Brush and spray method.
2. Dipping or soaking treatment
3. Pressure treatment

PLYWOOD: Plywood is made up of three or more layers.

Out of these the central layer, called core, is usually thicker and of relatively inferior wood than the face veneers.

The veneers glued at the top and the bottoms are known as face plys.

The surface grains of adjacent layers are kept at right angle to each other.

This arrangement prevents the plywood from warping and shrinkage.

The common method of joining the plys for obtaining the plywood is the following:

1. Cold pressing method
2. Hot pressing method

ADVANTAGES OF PLYWOOD:

1. It is lighter in weight than a solid stock of the same thickness.
2. It is much stronger than solid stock of the same thickness.
3. It can be obtained in very large sizes, which are impossible in solid wood.
4. It can be easily worked and bent into shapes of different designs.
5. Nails and screws can be driven close to the edge of plywood without any danger of splitting.
6. Top veneers can be given fine decorative effects to give attractive appearance.

WOOD WORKING HAND TOOLS:

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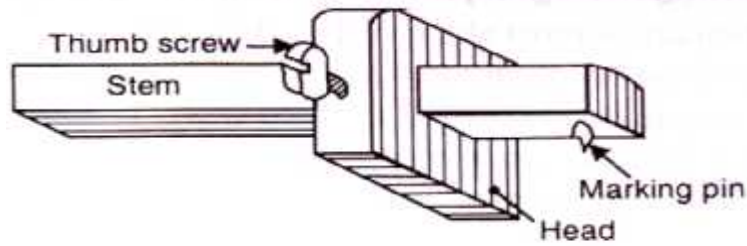


Fig. 9.9. Marking gauge.

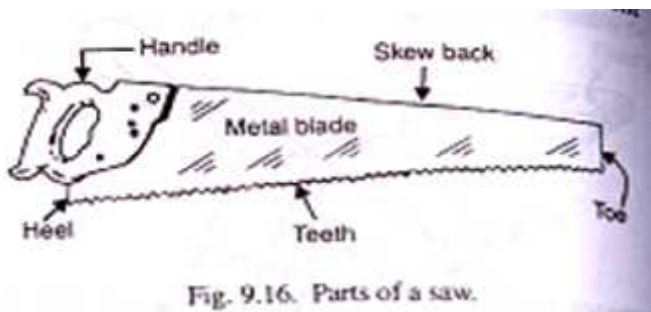


Fig. 9.16. Parts of a saw.

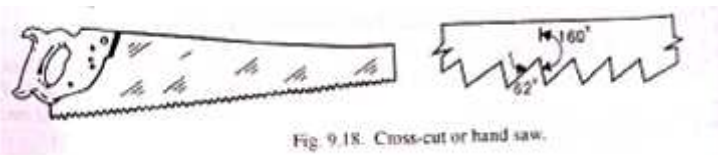


Fig. 9.18. Cross-cut or hand saw.



(a) Round chisel.



(b) Hexagonal chisel.



(c) Oval chisel.



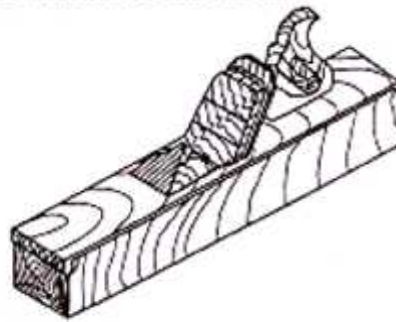
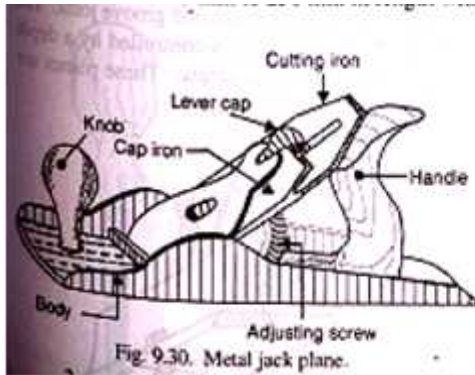
(d) Socket chisel.



(e) Outside ground gouge.



(f) Inside ground gouge.



A broad classification of these tools according to their use is as follows.

1. Marking and measuring tools.
2. Holding and supporting tools
3. Cutting tools
4. Planing or paring tools
5. Boring tools
6. Striking tools
7. Miscellaneous tools

1. Marking and Measuring tools:

Carpenter's folding rule: It is mainly used for measuring and setting out dimensions. It is a wooden scale consisting of four pieces.

Try square: It is used for measuring and setting out dimensions, testing the finish of a planed surface, draw parallel lines at right angle to a plane surface, draw mutually perpendicular lines over a plane surface and the sequences of two adjacent surfaces.

Straight edge: It is used for testing the trueness of surfaces and edges.

Bevel square: It is used for setting, duplicating, testing and comparing angles and bevels.

Scriber or Marking knife: It is mainly used for locating and marking points and scribing lines on wood surface.

Marking gauge: It is made of wood and is a very prominent tool for marking. Scribing (along the line of desired distance) is made possible with the help of thumbscrew.

Mortise gauge: It is an improved form of marking gauge. Its specific use in marking mortises and tenons and other similar joints requiring such parallel lines.

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Cutting gauge: It is mainly used for cutting parallel strips out of thin sheets of wood, up to 3mm. Thickness, and for marking deep lines across the grains of the wood in the thicker sections.

2. Holding and supporting tools:

Workbench: It is a heavy table of rigid construction on which two or four vices are fitted on opposite sides to hold the jobs during the operation.

Bar clamp: The specific use of this tool is in holding the glued pieces tightly or holding firmly two or more unglued pieces for fitting dowels or doing other operations on them in assembled position

Clamps and screws: Various types of clamps and screws are used by carpenters for holding and supporting wood pieces in position for carrying out different operations. Two common types are..

‘C’ clamp

Hand screw

3. Cutting tools: There are three types of cutting tools used in the wood work:

Those, which are given a reciprocating, motion by hand and carry teeth for cutting the wood- saws.

Those, which are driven into the wood by the application of blows- chisels.

Those which are given a swinging action by one hand or both hands and are struck against the wood for cutting the same.

Types of saws:

1. Ripsaw: It cuts the wood along the grain. It is used for smaller and medium work.
2. Panel saw: It is the most commonly used handsaw. It is mainly used for cutting panels for the door shutters.
3. Compass saw: It carries a tapered blade. The blade is quite flexible and, thus it can be used easily for taking straight or curved cuts on outside or inside of the wood.
4. Keyhole saw: This saw is very useful in internal and intricate work.
5. Cross cut saw: It is primarily designed for cutting across the grains of wood but is used as a general purpose saw in woodwork.
6. Tanoan saw or back saw: It is used for finer work than the rip saw, panel saw or cross cut saw. The main use of this saw is in taking short straight cuts, such as for tenons.
7. Dovetail saw: It is also used for finer work, particularly for cutting tongues for dovetail joints.
8. MITRE joints: It is used in conjunction with a mitre box.
9. Bow saw: This saw is used for the same purpose as a compass saw, but for finer curves and profiles

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Types of chisels:

Firmer chisel: It is a general-purpose chisel and is used for taking wider cuts and finishing flat surfaces inside the grooves.

Dovetail chisel: The beveled shape enables reduction of blade thickness on the sides due to which it can enter sharp corners to finish them.

Mortise chisel: It is used for taking heavy and deep cuts resulting in more stock removal, as in case of making mortises.

Socket chisel: When a very heavy stock removal is to be done by the chisel, it is bound to result in splitting of the wooden handle due to heavy blows on its top. To prevent this, such chisels are provided with a socket type construction at their top in place of the tang.

Gouge chisel: It carries a hollow curved blade for finishing curved surfaces.

PLANING OR PARING TOOLS:

1. Wooden jackplane:

2. Iron jackplane: It is also used for the same purpose as a wooden jackplane, but it gives a better finish than the latter. It is more rigid than others and has longer life than others, but is equally costly also.

(i) Trying plane: It is applied after the surface has been planed by a jackplane in order to make it a true flat surface.

(ii) Smoothing plane: It is used for providing better finish and smoothness to the surface already planed by a jackplane. Its specific use is in the places where lack of space will prohibit the use of jackplane.

STRIKING TOOLS:

1. Mallet: It is used for striking the cutting tools, which have a wooden handle.

2. Claw hammer: It consists of two faces

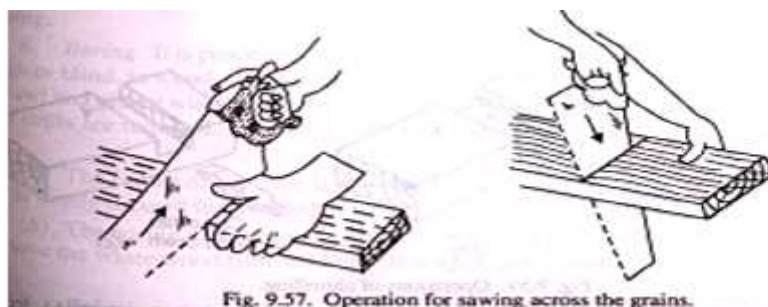
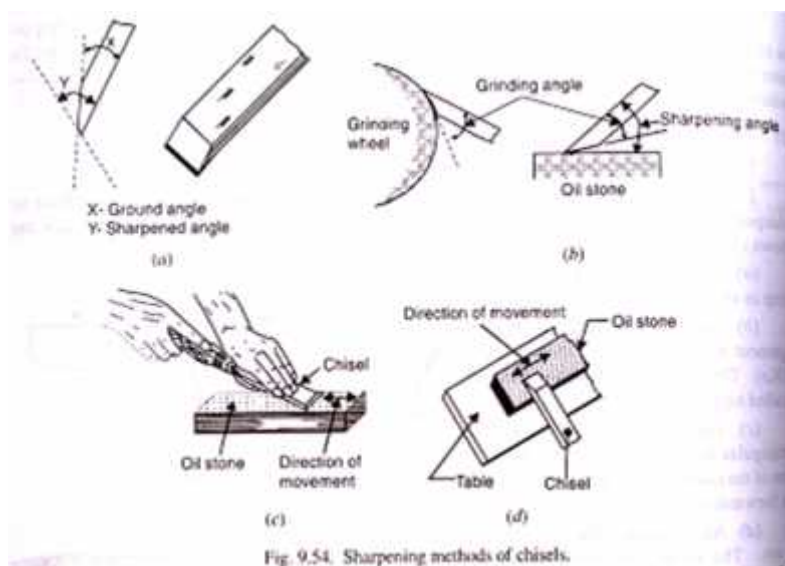
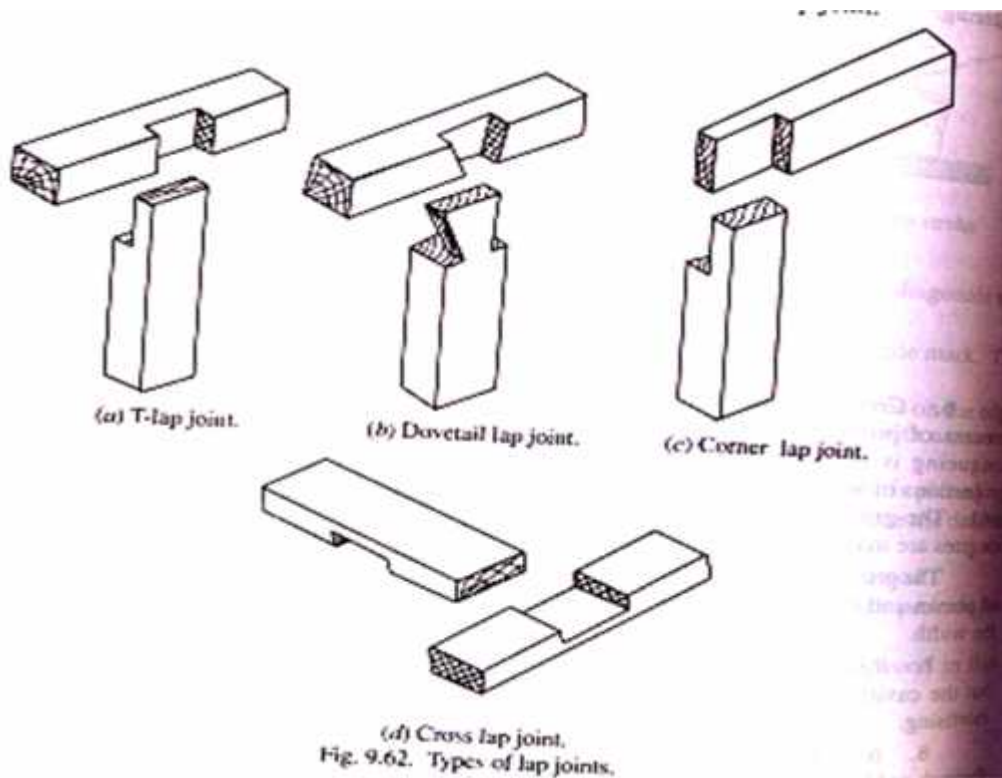
1. Striking face= for striking purposes

2. Claw = for extracting nails out of the wood.

LAP JOINTS: Lap joints are very frequently used to connect two wooden pieces such as boards, which are required to cross each other and at the same time remain in the same plane, so that an even surface is obtained at the joint. When the intersecting members cross each other at their centers, it is known as center lap joint, when somewhere between centers it is known as a cross lap joint and when at ends it is known as an end lap joint.

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EXPERIMENT No. 1.1

Aim:-To prepare a T lap joint/Bridle joint as per drawing.

Tools & equipments: Try square, scale, pencil, carpentry vice, marking gauge, hammer, screwdriver, measuring tools etc.

Materials: Wooden piece.

Procedure:

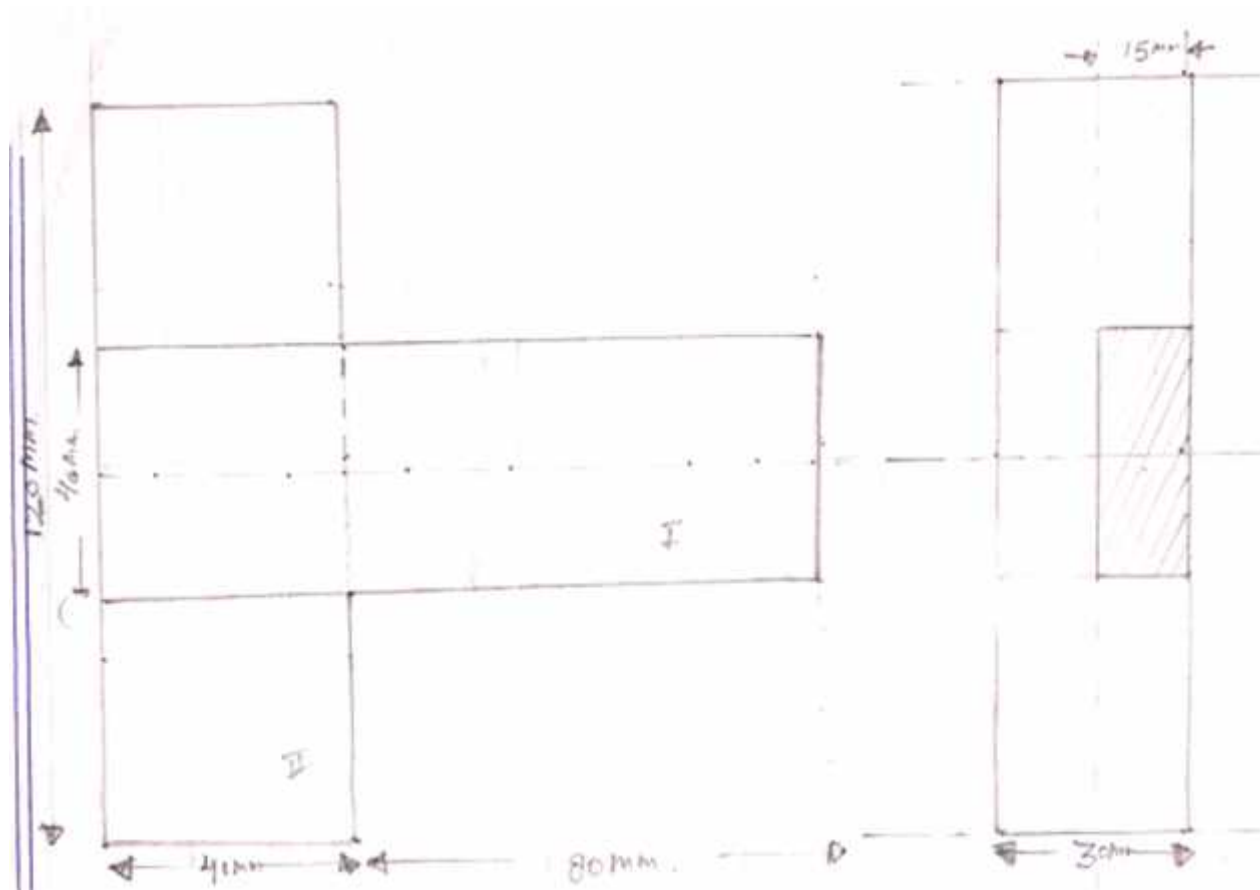
1. Collect tools & material from workshop store.
2. Plane the piece of in rectangular shape as per dimensions.
3. Mark the exact location on the surface where the joint in to be made.
4. Hold the job on carpentry vice.
5. Make groove of required width and depth.
6. Select the type of fastener (nails, screw, wooden pin)
7. Hold piece to be joined in their respective position.
8. Check the joint.

Result: T lap joint / bridle joint as pre given dimension has been made.

Safety precautions:

1. Use properly sharpened tools.
2. Use seasoned wood.
3. Tools should be in proper conditions.
4. Don't place the wood against the direction of grains.
5. Grip of vice should be strong while material is being worked.

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T-JOINT



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Foundry Shop

Introduction

The pattern making deals chiefly with the construction of patterns. A pattern may be defined as a model or replica of desired casting which when moulded in sand forms an impression called mould. The mould when filled with molten metal forms casting after solidification of the poured metal. The quality and accuracy of casting depends upon the pattern making.

Pattern Materials

There are several materials commonly used in the construction of patterns. The modern pattern making employs the use of materials that can be easily shaped and are durable. The type of pattern material chosen depends upon the following factors:

- a) The design of casting,
- b) The number of castings to be produced,
- c) The type of casting and moulding process used in foundry, and
- d) The degree of accuracy and surface finish required.

Following are the commonly used materials for pattern making:

1. Wood: It is widely used material for patterns. It is used when small number of castings is to be produced. The wood as a pattern material has the following advantages and disadvantages.

Advantages:

- a) It is cheap and light.
- b) It can be easily worked and shaped as desired.
- c) It can be cut and fabricated into numerous forms by gluing, bending and carving.
- d) It is easily planned and sanded to smooth surface and can be preserved fairly for a long time with shellac.

Disadvantages:

- a) It has the tendency to wear out by the constant contact with damp sand.
- b) Since it can not withstand the continuous abrasive action of sand, therefore it is unsuitable for repetition work.

The pine, deodar, teak, kail, shisham and mahogany are the commonly used woods for patterns, but mahogany is more durable for heavy duties of repetition moulding. The wood selected for pattern making should be free from knots and it should be properly seasoned before use.

2. Metal: When large number of castings is required, the pattern is made of a metal. The metal patterns are more durable, have longer life and produces moulds to a close dimensional accuracy. Following materials are commonly used for pattern making:

3. Cast Iron: It is cheap, easy to file and fit. It is strong, gives a good smooth mould surface with sharp

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broken. Though the cast iron can be cast into fairly thin sections, but there is a danger that the edges of thin sections, which cool very quickly, may be too hard to machine. The patterns for small and light work are not ordinarily made of cast iron because of their tendency to rust.

4.Brass: It is strong, tough, rust proof and takes better surfaces finish than cast iron. It has the ability to withstand wear of the moulding sand. It can be used successfully for casting very thin sections without danger of encountering unmachinable edges. The small patterns can be easily rectified, built-up or fitted by soldering. Since the brass patterns are heavier and costlier than cast iron, therefore it is used only for patterns or sections of pattern and not for the plates on which the patterns are mounted.

5.Aluminum and its alloy: The aluminium and its alloy having 80 percent aluminium, 14 percent zinc, 3 percent copper, 1.5 percent iron and 1.5 percent silicon, are widely used for production moulding due to its light weight, strength, corrosion resistance and machining characteristics. Since the aluminium and its alloys are softer than brass or cast iron, therefore the patterns are liable to be damaged by accidental contact with the steel ramming tools. Though they are fairly resistant to sand abrasion, yet it is advisable to protect critical locations with steel or iron insertions.

6.White Metal: It is not used to any great extent for patterns, but is the best material used for dining stripping plates, because it can be cast into the narrow cavities between the master pattern and frame of the stripping place. It is an alloy of lead, copper and antimony and has a low melting point about 260°C. The white metal patterns are soft and easily worn away by the moulding. Since it is commonly used for die casting, therefore, it may be called as die casting alloy.

7.Plaster: The plaster of paris or gypsum cement is successfully used as a pattern material because it can be easily casted into intricate shapes and can be easily worked. It has a high compressive strength (up to 30 MPa) and controlled expansion. It is used for making small patterns and core boxes of intricate shapes.

8.Plastics: The thermo-setting resins, usually phenolic resin plastics, are now gaining popularity as a plastic material of patterns. The plastics are light in weight, have high strength, high war resistance, high corrosion resistance, low solid shrinkage and have very smooth surface finish. In order to make plastic patterns, first of all a master pattern from wood is made and then a plaster of paris mould is prepared from this master pattern. The plastic resin is now poured in the mould and heated to some specific temperature. After solidification, it produces a plastic pattern. In large scale production, numerous plastic patterns of similar shape and size can be mounted on match plates so as to reduce the unit cost of casting.

9.Wax: It is used for investment casting process. It helps in imparting a high degree of surface finish and dimensional accuracy to castings. The wax pattern is prepared by pouring heated wax into the split moulds or a pair of dies while the latter are kept water cooled. The dies after having been cooled down are parted off. The wax pattern is now taken out and used for moulding.

Pattern making Tools

A pattern maker is basically a carpenter. Therefore, a pattern maker uses the same tools, as issued in the previous chapter. In addition to these tools a special scale known as shrink scale or known as a cope. The line of separation of the parts is called parting line or parting surface.

Sometimes a pattern for complex castings is made in three parts. Such a pattern is called a multi-piece pattern. A three piece pattern requires a moulding box with three parts, in the middle one being called as cheek.

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The split patterns are commonly used for casting of spindles, cylinders, steam valve bodies, water stop-cocks and taps, bearings, small pulleys and wheels.

Match Plate Pattern

The match plate patterns are used on machine moulding for quantity production of castings. A single pattern or a number of patterns may be mounted on a match plate. When the cope and drag portions of the split pattern are mounted on opposite sides of the wooden or metal plate (usually aluminum plate), the pattern is called a match plate pattern. The gates and runners are permanently fastened to the drag side of the plate in their correct positions in order to form a complete match plate. When the match plate is lifted off the mould, all patterns are withdrawn and the gates and risers are completed in one operation.

The fig. Shows a match plate pattern upon which the patterns of two small dumb bells are mounted. Though the cost of construction of the match plate patterns is quite high, yet it is easily compensated by the high rate of production, greater dimensional accuracy and minimum requirement of casting.

Cope & Drag Pattern

When very large castings are to be made, the complete mould becomes too heavy to be handled by a single operator. In order to ease this problem, the cope and drag pattern is used. It is nothing but a two-piece pattern, split on a convenient part line. One part is moulded in cope and the other part in a drag of the moulding box.

Loose Piece Pattern

Sometimes a pattern has to be made with projections or overhanging parts, as shown in figure. These projections make removal of the pattern difficult. Therefore, such projections are made in loose pieces and are fastened loosely to the main pattern by means of wooden or wire down pins. These pins are taken out during the moulding operation. After moulding, the main pattern is withdrawn first and then the loose piece is removed with the help of a lifter.

Gated Pattern

The gated pattern, as shown in Fig. 10.8 is used for mass production of small castings. When a number of small patterns are placed in a single mould, then each pattern may be provided with a gate pattern with it. It consists of pieces of wood or metal fixed to the patterns to form the runner and rising channels in the mould. In this way, full supply of the molten metal flows into every part of the mould.

The gated pattern eliminates hand cutting of gates and thus makes the moulding easy, if a group of patterns is to be placed in one mould, the gate pattern has a further function of holding the patterns in the proper position with respect to each other.

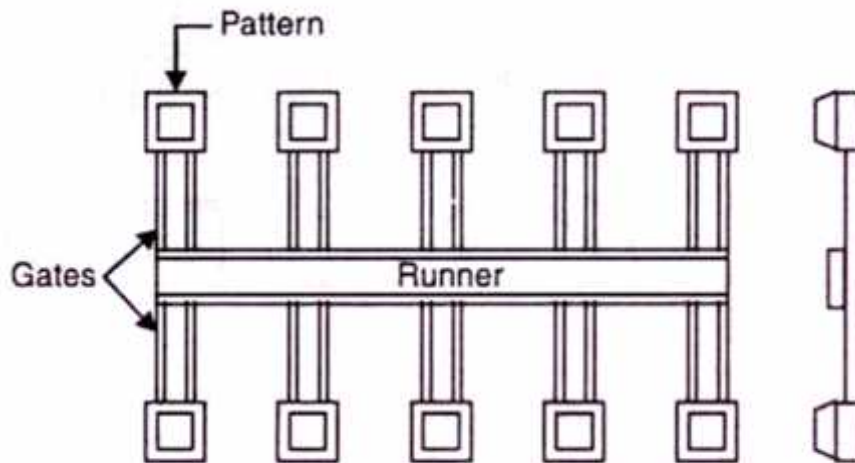


Fig. 10.8. Gated pattern.

Sweep Pattern

The moulds of large size and symmetrical in shape particularly of circular section can be easily prepared by using a sweep instead of a full pattern. It is not considered as a true pattern when compared with others. A sweep is a template of wood or other material which has the shape corresponding to the shape and size of casting. It is arranged to rotate about a central axis by mounting it on a spindle. The sand is rammed in place with a cavity of approximately similar shape and size to that of the required mould. Now by revolving the sweep, the desired shape of the mould is generated. The sweep and the spindle are then removed and the hole in the centre is filled up.

A curved sweep which may be used to form part of the mould for a large cast iron kettle. A straight sweep for any type of groove or ridge. The principal advantage of this pattern is that it eliminates expensive pattern construction.

Skeleton Pattern

When a few and large-sized castings are required, it is not advisable to use a large solid pattern of that size, as it will require a lot of wood and time to make a full pattern. In such cases, a skeleton pattern in the hollow form, consisting of a wooden frame and strips, is used.

The frame work is filled and rammed with loam sand and a stickle board, as shown in figure is used to scrap the excess sand out of the spaces between the ribs so that the surface is even with the outside of the pattern. The Skelton pattern is made in two halves, one for the cope and the other for the drag. After taking the impression, the cope and drag are assembled together with the core in position to form the complete mould. The skeleton patterns are used for castings of hollow cast iron pipe, bends, valve bodies and boxes.

Shell Pattern

The shell pattern is used largely for drainage fittings and pipe work. This type of pattern is usually made of metal mounted on a plate and parted along the entire line, the two sections being accurately doweled together. The short bends are usually moulded and cast in paris. The shell pattern is a hollow construction like shell. The outside shape is used a pattern to make the mould while the inside is used as a core box for making cores.

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Segmental Pattern

The segmental patterns are also known as part patterns. These patterns are sections of a pattern so arranged as to form a complete mould by being moved to form each section of the mould. These patterns are usually applied to circular work, such as rings, wheel rims, gears etc. When a mould is to be made using a segmental pattern, a vertical spindle is firmly fixed in the centre of a drag flask. The mould bottom is rammed, and swept level. Now the segmental pattern is fastened to the spindle. The moulding sand is rammed between the outside of the pattern and the flask and on the inside except as the ends of the pattern. After ramming one segment is rammed, and so on until entire perimeter of the mould is completed.

Follow Board Pattern

A follow board pattern is used for solid patterns having an irregular parting line. It may be used with either single or multiple gated patterns. The patterns requiring follow boards are usually somewhat difficult to make as a split pattern. The board is routed out so that the patterns rests in it up to the parting line and this board then acts as a moulding board for the first moulding operation.

Lagged-up Pattern

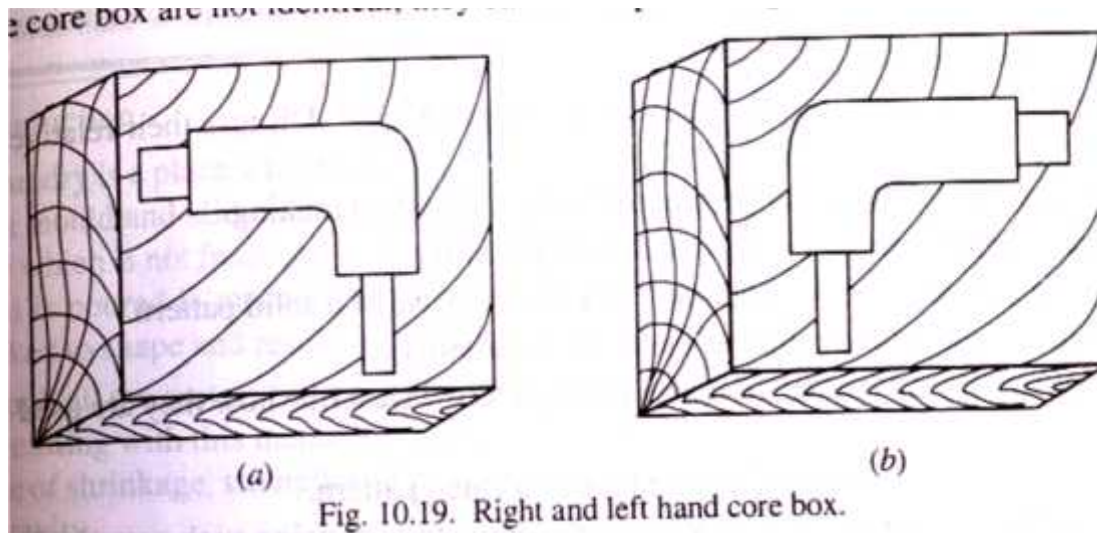
When a pattern or core box is so large or of such a form that it can not be made economically from a solid piece or when such method would result in a pattern of little strength or excessive weight, it is necessary to use a lagged or staved pattern.

The cylindrical patterns e.g. barrels, pipes or columns are built up with lag or stave construction to ensure proper shape. The lags are longitudinal strips of wood beveled on each side for making the tight outside. These lags are glued and nailed or screwed to the wooden end pieces called heads. Such a construction gives the maximum amount of strength and permits building close to the finished outline of the pattern so that there is comparatively little excess stock to be removed to bring it to the required form. In building pieces that are not cylindrical, the heads are frequently cut to follow a line parallel to the finished outline of the pattern, so that the staves, when listened in a place, will closely approximate this outline.

Left and Right Hand Pattern

Some patterns are required to be in pairs, and when their form is such that they can not be reversed and have the centers of hubs, bosses etc. opposite and in line, then they must be made right and left hand separately. A few examples where a pair of left and right hand patterns is required are legs for wood turning lathe, J-hangers for overhead shafting, legs for garden bench, legs for paddle type sewing machine, brackets for luggage racks in the railway carriages etc.

A bracket is an example of left and right hand pattern. The hub and the foot flanges are fastened with screws and are moved from side to side to make the pattern right and left hand, as shown by dotted lines in the figure. The ribs are also loose. The rib C is reversed, but right and left hand ribs D are required because of the angle at the lower edge.



Core Boxes

The core boxes, like patterns, may be made either of wood or metal. The core boxes are used for a casting requiring cores. Wood is generally used for making core boxes, but metal core boxes are preferred where cores are to be prepared in large numbers on mass production basis. Following are the various types of core boxes commonly used:

1. Half core box: A half core box, is the most common type of core box. It is used for preparing the two identical halves of a symmetrical core. The two halves are then pasted together after baking to form a complete core.

2. Dump core box: A dump core box is similar to half core box, but the core produced by this core box do not require pasting and they are complete by themselves. If the core produced is in the shape of slab, then it is called as a slab box or a rectangular box.

3. Split core box: A split core box is in two parts and a complete core is produced in a single ramming. The two parts are held in position by means of clamps and alignment is maintained by means of dowel pins. Sometimes, the parting surface of the two halves is alignment is maintained by means of dowel pins. Sometimes, the parting surface of the two halves is made along an irregular line to eliminate the use of dowels. For preparing the core, the core sand is rammed from one side. After ramming and striking off the excess sand, the core box is unclamped and rapped. Thus, a complete core is produced in a single ramming.

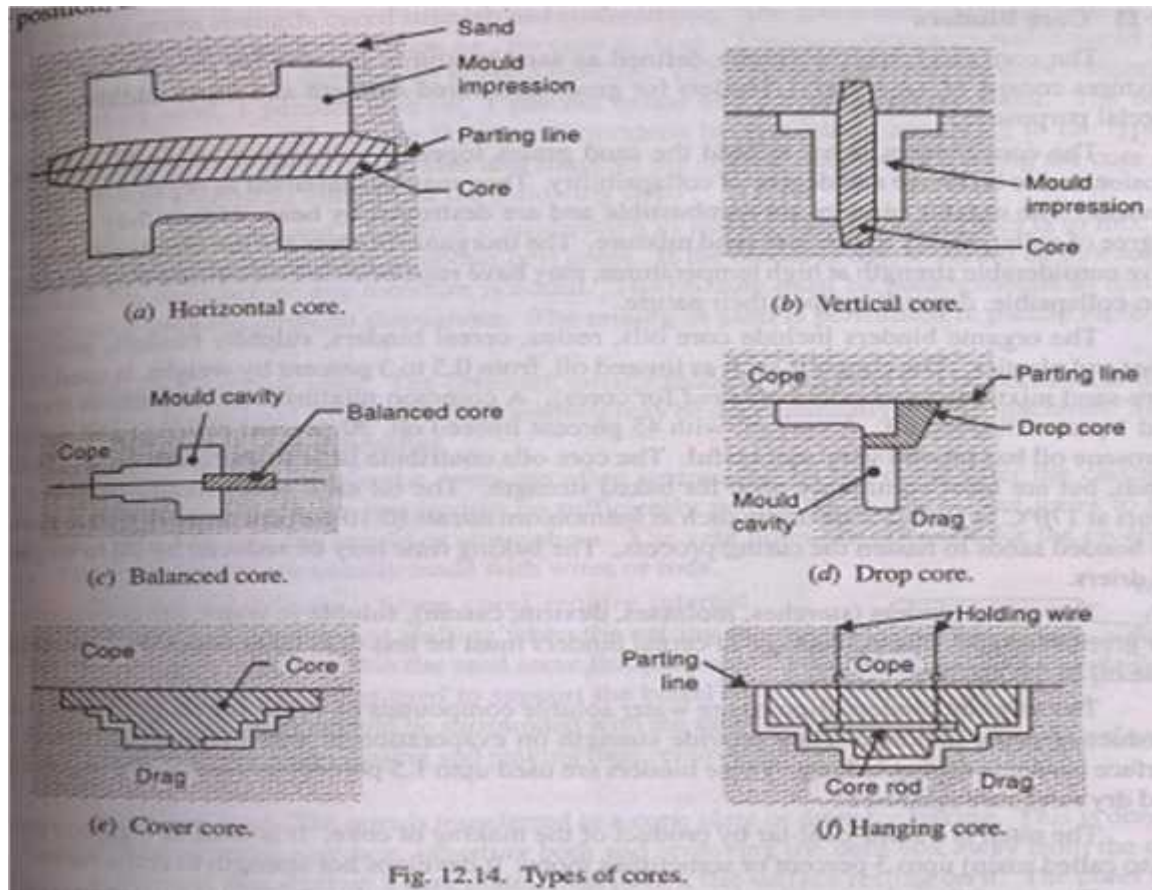
1. Strickle core box: A strickle core box, is used when the core is required to have an irregular shape which cannot be easily rammed by other methods. The desired irregular shape is achieved by striking off the core and from the top of the core box with a piece of wood called a strickle board. The strickle is cut to correspond exactly to the contour of the required core.

2. Right and left hand core box: The right and left hand core boxes are used when the cores are not symmetrical about the centre line and the two halves of the core made in the same core box are not identical, they cannot be pasted together to form an entire core.

3. Loose piece core box: A loose piece core box is used for making cores when provision for bosses, bubs etc. is required. In some cases, both halves of the right and left core can be prepared from a single core box with the help of loose pieces. One half of the core is prepared with the loose piece

placed in the left hand recess and the other half is prepared by shifting the loose piece to the right hand recess.

4. Gang core box: A gang core box, is used when large number of small sized cores are to be prepared. In this type of core cavities are rammed in a single operation.



Pattern:-Pattern is a replica of the final object to be made with some modifications. The mould cavity is made with the help of the pattern.

Core:-It is used for making hollow cavities in castings as shown in figure.

Sprue :-The passage through which the molten metal from the pouring basin reaches mould cavity. In many cases it controls the flow of metal into the mould as shown in figure.

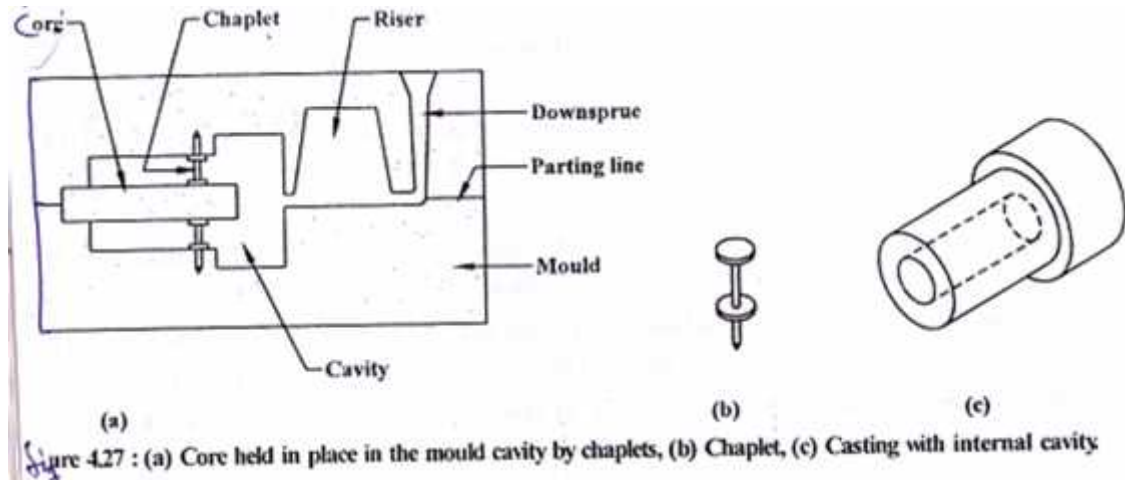
Runner:-The passage ways in the parting plane through which molten flow is regulated before they reach the mould cavity.

Gate:-The actual entry point through which molten metal enters mould cavity.

Chaplet:-Chaplets are used to support cores inside the mould cavity to take care of its own weight and overcome the metallostatic forces as shown in figure.

Chill:-Chills are metallic objects which are placed in the mould to increase the cooling rate of castings to provide uniform or desired cooling rate as shown in figure.

Riser:-It is a reservoir of molten metal provided in the casting so that hot metal can flow back in to the mould cavity when there is a reduction in volume of metal due to solidification as shown in figure. The riser must be designed to freeze after the main casting in order to satisfy its function.



Properties of Moulding Sands

Some of the important properties of moulding sand, for obtaining good mould and castings mentioned below:

Strength: The mould's ability to maintain its shape and resist erosion caused by the molten metal; it depends on grain shape, adhesive qualities of the binder, and other flow of.

Permeability: The capacity of the mould to allow hot air and gases from the casting operation to pass through the voids in the sand.

Thermal Stability: The ability of the sand at the surface of the mould cavity to resist cracking and buckling upon contact with the molten metal.

Collapsibility: The ability of the mould to give way and allow the casting to shrink without cracking the casting; it also refers to the ability to remove the sand from the casting during cleaning.

Reusability: The sand from the broken mould be reused to make other moulds.

Constituents of Moulding Sand

The principal constituents of moulding sand are:

1. Silica sand
2. Binder
3. Additives, and
4. Water

Silica Sand: Silica Sand (SiO_2) contains water for a long time and is suitable for a wide working range. It helps to patching and finishing operations of the mould. It is very cheap as compare to other sand. Mostly used for cast iron and non ferrous metals casting.

Binders: The purpose of adding a binder to the moulding sand is to impart it sufficient strength and

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withdrawn. However, it produces an adverse effect on the permeability of the sand mould. The common binders used in foundry can be grouped as:

- i) Organic Binders
- ii) Inorganic Binders

Organic Binders find their specific use in core making. The common binders coming in this category are:

- a) Dextrin
- b) Molasses
- c) Linseed Oil
- d) Cereal Binders
- e) Pitch-up to 2% max.
- f) Resins, like phenol and urea formaldehydes.

In the Inorganic Group the common binders are clay, sodium silicate and Portland cement. Out of all these, the clay binders are commonly used. The following types of clays are commonly used:

- a) Bentonites
- b) Kaolinite
- c) Limonite
- d) Ball clay
- e) Fire clay
- f) Fuller's earth

Out of the above six varieties Bentonite is most widely used. In our country its deposits are found in Bihar, Rajasthan and Kashmir.

Additives: Additives are those materials which are added to moulding sand to improve upon some of the existing properties or to impart certain new properties to it. The commonly used additives are:

Coal Dust: It is mainly used in the sand used for grey iron and malleable iron castings. Its main purpose is to react chemically with the oxygen present in the sand pores, and thus produce a reducing atmosphere at mould-metal interface and prevent oxidation of the metal. For this reason its major portion is added in the facing sand. It, however, reduces the cohesiveness and strength of the sand.

Sea Coal: It is a finely ground soft coal and is vastly used in sand used for grey and malleable form castings. It restricts the mould wall movement and improves surface finish. It reduces sand. Its proportion varies from 2 to 8 percent.

Cereals or Cornflower: It promotes mould wall movement by being volatilized by reduces expansion defects, improves strength, toughness and collapsibility of the sand and decreases permeability and flow ability. Its proportion in the sand varies from 0.25 to 2.0 percent.

Silica Flour : It increases hot strength, decreases metal penetration into the mould, reduces expansion defects and improves surface finish. It may be added up to 35 percent.

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Wood Flour : It promotes mould wall movement, reduces expansion defects and increases collapsibility, improves surface finish and thermal stability of mould. It may be added from 0.5 to 2.0 percent or even more.

Pitch: It improves hot strength and surface finish on ferrous castings. It can be advantageously added up to 2.0 percent. If a higher proportion is added it will reduce green.

Dextrin and Molasses: Their addition increases the dry strength of the sand. In other respects they behave more or less like cornflower.

Fuel Oil : Its addition is sometimes done in order to reduce the requirement of free water in the sand.

1. Water: The clay content added to the foundry sand will not give the required strength and bond until a suitable quantity of water is added to it. This quantity of water varies from 2 to 8 percent according to different requirements.

The water content present in the sand mass is partly in mixed form called pore water, and partly in the Free State, known as free water. When water is added to the clay it starts and partly in the Free State, known as free water. When water is added to the clay it starts filling into the pores of the clay, where it forms a sort of micro-film. This content is held rigidly by the clay and it is mainly responsible for enabling the clay to impart the desired strength to the sand. The quality of bond and the capacity of clay for providing the bond will mainly depend upon the thickness of the water film that it can hold.

When more water is added to the clay mixture than the amount required as pore water, it remains as a fluid and is held between the clay particles separating them. It has been found that this excess amount of free water behaves as a lubricant and thus, improves the mould ability and plasticity of the moulding sand. It, however, reduces the strength of the mixture and, thus weakens the mould.

Mould Classifications

Moulds are classified as follows:

1. Sand Moulds: Depending upon the type of sand used, there are different types of moulds, namely,

Greensand : Greensand moulds are made of a mixture of sand, clay, and water, the word 'green' referring to the fact that the mould contains moisture at the time of pouring, Greensand moulds possess sufficient strength for most applications, good collapsibility, good permeability, and good reusability and are the least expansive of the moulds. They are the most widely used mould type, but they are not without problems. Moisture in the sand can cause defects in some castings, depending on the metal and geometry of the part.

Dry sand moulds: A dry-sand mould is made using organic binders rather than clay, and the mould is baked in a large oven at temperatures ranging from 20°C to 316°C. Oven baking strengthens the mould and hardens the cavity surface. A dry-sand mould provides better dimensional control in the cast product compared to green sand moulding. However, dry-sand moulding is more expensive, and the production rate is reduced because of drying production rates.

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Skin dried mould: In a skin-dried mould, the advantages of a dry-sand mould are partially achieved by drying the surface of a greensand mould to a depth of 0.5 to 1 inch at the mould cavity surface, using torches, heating lamps, or other means. Special bonding materials must be added to the sand mixture to strengthen the cavity surface.

DEFECTS IN CASTINGS

The defects in a castings may be due to pattern moulding box equipments moulding sand cores gassing system or molten metal. Some of the defects & their reasons are discussed below.

Mould shift: it results in mismatching of the top & bottom parts of casting. misalignment of pattern parts due to worn or damaged pattern.

Core shift: It is an abnormal variation of dimensions which are dependent on core position misalignment of cores in assembling cored moulds by using incorrect size of chaplet .

Swell : it is an enlargement of the mould cavity by molten metal pressure resulting in localized or general enlargement of casting. Insufficient ramming of sand ,insufficient weighting of mould during casting pouring of molten metal too rapidly or too hard

Sand wash: It usually occurs near ingates as rough lamps on surfaces of casting sand that has been washed away appears on upper surfaces of castings as rough holes or depression this is reasons soft ramming of sand, weak sand, poor pattern, insufficient draft.

Shrinkage: it is crack in the casting or dishing on surfaces of castings which results from unequal contraction of metal during solidification ,improper location size of gates ,inadequate risers, lack of directional solidification incorrect metal composition incorrect pouring temperatures

Hot tear: It is an internal or external ragged discontinuity in the metal casting resulting from hindered contraction occurring just after metal has solidified , abrupt change in section inadequate filleting of inside corners & improper placement of chills, improper pouring temperature.

Sand blow or blow hole: It is an excessively smooth depression on the outer surface of casting this defect is also called blow holes, high moisture content in moulding sand, low permeability of sand, hard ramming of sand defective gassing system.

Core blow: It is an excessively smooth depression on the inner surface of cored cavity or gas pocket immediately above cored cavity.

Scabs: These are patches of sand on the upper surfaces of casting this defect is due to the following reasons, uneven ramming of sand, slow or intermittent of metal.

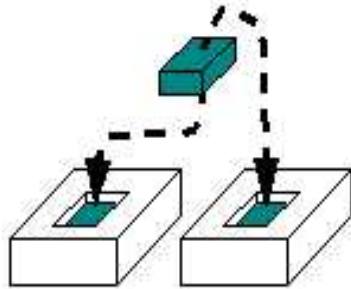
Cold shuts and misruns: These occur when mould cavity is not completely filled and an incomplete casting results. This defect is due to the following reasons, too small gates, too many restrictions in the gassing systems, pouring head is too low, facility venting of moulds metal lacking in fluidity.

Metal penetration: It occurs when alloy being cast tends to penetrate into sand grains causes fused aggregate of metal sand on the surface of the casting .it is due to the following reasons, soft rammed sand, moulding sand and core sand being too coarse, improper use of mould and core washes will cause penetration, excessive metal temperature or increased fluidity metal.

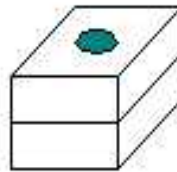
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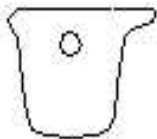
Run outs bust outs: these permit drainage of the metal from cavity results in incomplete casting, pattern that is too large for a given flask or pattern placed too close to flask edge results in weak spot cause runout, match plate surface that are out of parallel or uneven results in poorly formed parting line & cause run out, inadequate mould weights or clamps will permit cope to lift which results run out, improper sealing of mould joints cause runout



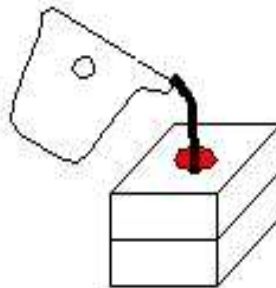
Pattern pushed into sand to make cavities. A runner-gate system will also be formed at this time. The sand will harden.



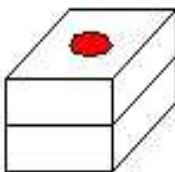
The patterns are matched with the pouring cup facing up.



Metal is heated and prepared metallurgically. It is put into a ladle/crucible/tundish/etc for pouring.



Molten metal is poured into the die.



The part is allowed to sit and cool (large parts may take days).



The part is removed from the sand with the runner/gate/etc still attached.



The part is finished and the surface is cleaned.

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Object: - 2.1 To prepare mould cavity with the given wooden pattern.

2.2 To prepare Aluminum casting with the help of given wooden pattern.

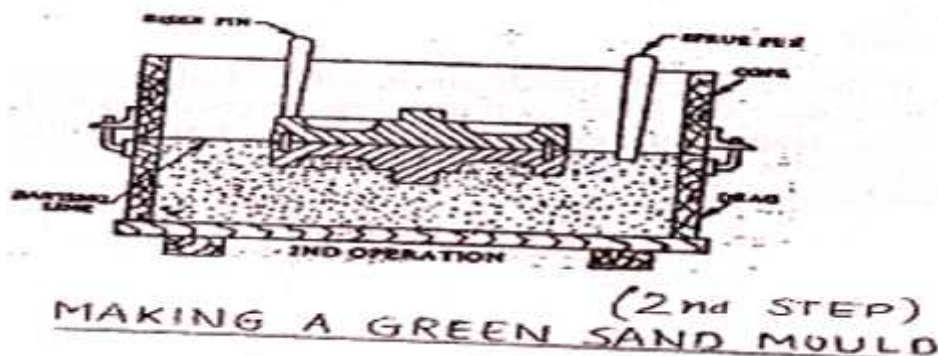
Tools and Materials:- Moulding sand, Aluminum , Mallet, Riddle ,square trowel, pan shape trowel, Moulding board, moulding box, parting of sand, flat rammer, side rammer, strike off bar, spirit level, solid pattern, sprue pin, riser pin, vent rod, slick, lifter, gate cutter.

Procedure:-Collect tools and material from workshop store. Take appropriate composition of moulding sand. Prepare moulding sand. Take moulding flask and pattern. Prepare mould, make runner, gate. Keep aluminum in the electric furnace, raise temperature of aluminum up to 820° C, so that solid aluminum changes into the liquid aluminum. Switch off supply to furnace. Pour molten metal into the mould through sprue hole till the cavity is full. Allow it to cool and thereafter take out the casting after breaking moulding sand.

Result:- Aluminum casting as per given wooden pattern has been prepared.

Safety Precautions:

1. Do not wear gauntlet/gloves.
2. Do not permit water to collect on the floor around a furnace.
3. Do not throw dump/wet metal into furnace.
4. Cover the floor under cupola by a thick layer of sand to avoid splashing.
5. Blow air through a crucible furnace before start.
6. Store crucible in warm dry place.
7. Thoroughly heat the ladles before use.
8. DO not move in backward direction while pouring molten metal.
9. Keep feet at a safe distance from the mould.
10. DO not place face directly over runners or risers while pouring.



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WELDING

The welding is a process of joining two similar or dissimilar metals by applications of heat with or without application of pressure and addition of filler material. The result is continuity of homogeneous material of the composition and characteristic of two parts, which are being joined together.

TYPES OF WELDING

The welding is broadly divided into the following two groups:

1. Force or pressure welding. In force or pressure welding (also known as plastic welding), the work pieces are heated to plastic state (except for cold pressure welding) and then the work pieces are joined together by applying pressure on them. In this case no filler material is used. The force or pressure welding is further classified as follows:-

2. Fusion or non pressure welding. In fusion or non pressure welding, the edge of work pieces to be joined and the filler material are heated to a temperature above the melting point of the metal and then allowed to solidify. The fusion or non pressure welding is further classified as follows:

GAS WELDING

Gas welding is done by burning or combustible gas with air or oxygen in a concentrated flame of high temperature. It can weld most common materials. Equipment is inexpensive, versatile and serves adequately in many job and general repair shops.

OXY-ACETYLENE WELDING

It is accomplished by melting the edges or surface to be joined by gas flame and allowing the molten metal to flow together it, thus forming a solid continuous joint upon cooling. The process is particularly suitable for joining metal sheet and plates having thickness of 2-50mm.

Weld ability

The term weld ability may be defined as the property of a metal which indicates the ease with which two similar or dissimilar metals are joined by fusion with or without the application of pressure and with or without the use of filler metal. Strictly speaking, a metal has good weld ability if it can be easily welded in a fabricated structure. The various factors affecting the weld ability of a metal are:

1. Composition of the metal
2. Brittleness and strength of the metal at elevated temperatures.
3. Thermal properties of the metal.
4. Welding techniques, fluxing material and filler material.
5. Proper heat treatment before and after the deposition of the metal.

The common metals having in the descending order are iron, carbon, steel, cast iron, low alloy steels and stainless steel.

Brazing

Brazing is a joining process whereby a non-[ferrous filler metal](#) or [alloy](#) is heated to melting temperature above 450°C (842°F), or, by the traditional definition that has been used in the United States, above 800°F (425)°C and distributed between two or more close-fitting parts by [capillary action](#). At its liquid temperature, the molten filler metal and [flux](#) interacts with a thin layer of the base metal, cooling to form an exceptionally strong, sealed joint due to grain structure interaction.

Advantages of brazing

1. The lower temperature of brazing and brass-welding is less likely to distort the work piece, significantly change the crystalline structure (create a [heat affected zone](#)) or induce thermal stresses. For example, when large iron castings crack, it is almost always impractical to repair them with welding. In order to weld cast-iron without cracking it from thermal stress, the work piece must be hot-soaked to 870°C (1600 °F). When a large (more than 50 kg (100 lb)) casting cracks in an industrial setting, heat-soaking it for welding is almost always impractical. Often the casting only needs to be watertight, or take mild mechanical stress. Brazing is the preferred repair method in these cases.
2. The lower temperature associated with brazing vs. welding can increase joining speed and reduce fuel gas consumption.
3. Brazing can be easier for beginners to learn than welding.
4. For thin work pieces (e.g., sheet metal or thin-walled pipe) brazing is less likely to result in burn-through.
5. Brazing can also be a cheap and effective technique for mass production. Components can be assembled with preformed plugs of filler material positioned at joints and then heated in a furnace or passed through heating stations on an assembly line. The heated filler then flows into the joints by capillary action.

Brazing processes

-) Pin brazing
-) Block Brazing
-) Diffusion Brazing
-) Dip Brazing
-) Exothermic Brazing
-) Flow Brazing
-) Furnace Brazing
-) Induction Brazing
-) Infrared Brazing
-) Resistance Brazing
-) Torch Brazing
-) Twin Carbon Arc Brazing
-) Vacuum Brazing

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In Braze Welding or [Fillet](#) Brazing, a bead of filler material reinforces the joint. A braze-welded tee joint is shown here.

Soldering

Soldering is the process in which two [metals](#) are joined together by means of a third metal or [alloy](#) having a relatively low [melting point](#). Soft soldering is characterized by the value of the melting point of the third metal or alloy, which is below 450°C.^[1] The third metal or alloy used in the process is called [solder](#).

Applications

The most frequent application of soldering is assembling [electronic components](#) to [printed circuit boards](#) (PCBs). Another common application is making permanent but reversible connections between copper pipes in [plumbing](#) systems. Joints in sheet-metal objects such as food cans, [roof flashing](#), [rain gutters](#) and automobile [radiators](#) have also historically been soldered, and occasionally still are. [Jewelry](#) and small mechanical parts are often assembled by soldering. Soldering is used to join lead [came](#) and [copper foil](#) in [stained glass](#) work. Soldering can also be used to effect a semi-permanent patch for a leak in a container or cooking vessel.

Soldering processes

-) [Wave soldering](#)
-) [Reflow soldering](#)
-) Infrared soldering
-) [Induction soldering](#) - An overview of soldering with induction and a collection of Application Notes
-) Ultrasonic soldering
-) [Dip soldering](#)
-) Furnace soldering
-) Iron soldering
-) Resistance soldering
-) Torch soldering

GAS WELDING

Oxy-fuel welding of metal is commonly called oxyacetylene welding since [acetylene](#) is the predominant choice for a fuel, or often simply oxy welding, or in [America](#), gas welding. In gas welding and cutting, the heat needed to melt the metal comes from a [fuel](#) gas burning with [oxygen](#) in a torch.

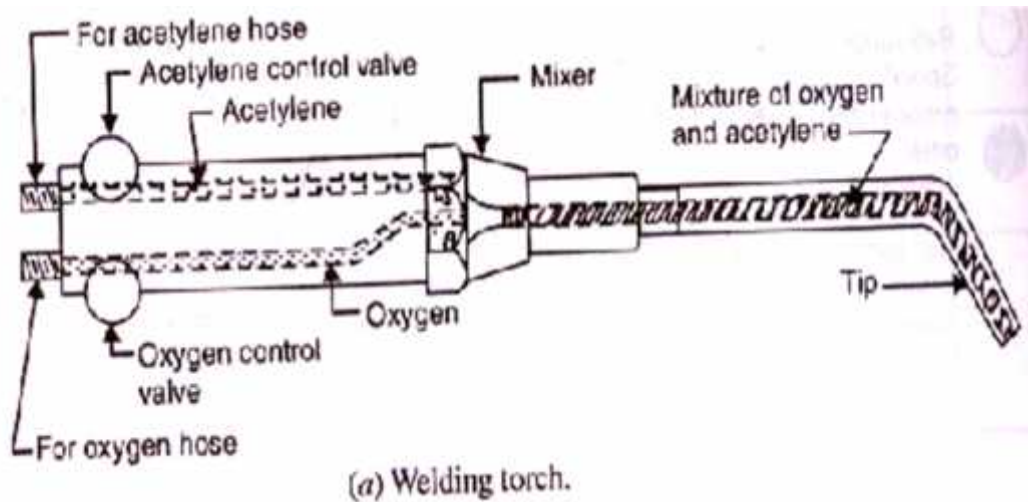
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1. **Welding torch:** this is a tool for mixing oxygen and acetylene in correct proportion and burns the mixture at the end of a tip. These are capable commercially in two general types

Equal pressure

Injector type



2. **Welding tip:**

It is that portion of the welding apparatus through which the gases pass just prior to their ignition and burning this is a variety of interchangeable welding tips of different size shape and contraction.

3. **Pressure regulator:**

The functions of a pressure regulator are:-

1. To reduce the cylinder pressure to the required rate
2. To produce a steady flow of gas (GAS volume rate).

Regulator may be classified into four main types-

1. The single stage steam type
2. The single stage steam type
3. The two stage type
4. The high capacity high pressure line type

4 **HOSE AND HOSE FITTING:**

The hose for welding torches should be strong, durable, non porous and light. The most common method of piping both oxygen and acetylene gas is the reinforced rubber hose, which comes in black, green and red.

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5 .GAGGLES, GLOVES, AND SPARK LIGHER

Goggles fitted with colored lenses are provided to protect the eyes from harmful heat and ultraviolet and infrared rays. Gloves are used to protect the hands from any injury.

Spark Lighter provides a convenient and instant means for lighting the welding torch.



GMAW Circuit diagram. (1) Welding torch, (2) Work piece, (3) Power source, (4) Wire feed unit, (5) Electrode source, (6) Shielding gas supply.

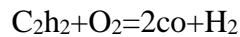
Gas welding technique: in a gas welding the acetylene is first of all turned on by using the control valve on the torch and then it is ignited with a fabrication spark lighter. The flame is adjusted by supplying the oxygen with the oxygen control valve on the torch. The piece to be welded are properly prepared and positioned. The weld is started by preheating and melting a small puddle of molten base metal. In case a welding rod is used to provide filler metal it should be in the flames so that its end melts at about the same time as the base metal. In order to obtain proper penetration and to its ends melts at same time as the base metal. In order to obtain proper penetration and to produce a good weld the tip of the torch should be moved with a side to side motion slowly and uniformly. The usually techniques in oxy-acetylene welding are as follows:

1. Left ward or fore hand welding : in this method the welding torch is held in the operator's right hand the tip pointing towards the left and the weld is made from right to left. The torch makes an angle of 60-70 degree the plate and the welding rod makes an angle of 30-40 degree as shown in fig.15.31. This method is more efficient for butt welding on plates upto 2mm thickness. The plate above 6mm thickness is not economical to weld with this method.

2. Right ward or back hand welding. In this method the welding torch is held in the right hand and filler rod in the left hand. The welding begins at the left hand ends of the joint and proceeds towards the right the filler rod is given circular motion while the welding torch moves in straight line. In this case the torch makes an angle of 40-45 degree with the plate and the welding rod makes an angle of 30-40 degree as shown 15.32 this method is better and economical for plates.

TYPES OF FLAMES:

The combustion of acetylene with pure oxygen at the tip of a gas welding torch takes place in two stages, in the first stage, the carbon from the acetylene combines with oxygen to form carbon monoxide, the hydrogen of the acetylene being freed. The following chemical reaction occurs:



This reaction takes place within the inner, brilliant white cone flame, close to the tip opening, as shown fig.15.29. This provides the most concentrated heat with the highest temperature for welding. In the second stage the carbon monoxide and hydrogen (produced in first stage), together with oxygen from the surrounding air, form carbon dioxide and water (steam). The reaction is represented by the following chemical equation: $4\text{CO} + 2\text{H}_2 + 3\text{O}_2 = 4\text{CO}_2 + 2\text{H}_2\text{O}$ this reaction takes place in the larger blue flame which surrounds the whitish cone flame. This larger blue flame contributes only a preheating effect for welding. It also protects the molten metal from oxidation. The flame can be adjusted, to suit the welding conditions, by regulating the supply of acetylene and oxygen. The following three types of flames are used for gas welding.

NEUTRAL FLAME: this type of flame is obtained by supplying equal volumes of oxygen and acetylene. The neutral flame as shown in fig.15.30 has the following two sharply defined zones: (a) an inner luminous cone and (b) an outer cone or envelope of bluish colour. The most of the oxy-acetylene welding (e.g., welding of steel, cast-iron, copper, aluminum etc) is done with the neutral flame.

OXIDISING FLAME. This type of flame is obtained where there is an excess of oxygen. It is similar to a neutral flame but the inner cone is less luminous and shorter, as shown in fig.15.30. It is used for welding brass and bronze.

REDUCING OR CARBORISING FLAME. This type of flame is obtained by supplying an excess of acetylene. This flame as shown in fig. 15.30 has the following three zones: (a) an inner cone, (b) an intermediate cone of whitish colorant (c) an outer cone of bluish colour. This flame is used where it is required to keep oxidation to a minimum. It is used for welding of molten metal, a certain alloy steel, many of the non ferrous, hard surfacing materials such as satellite.

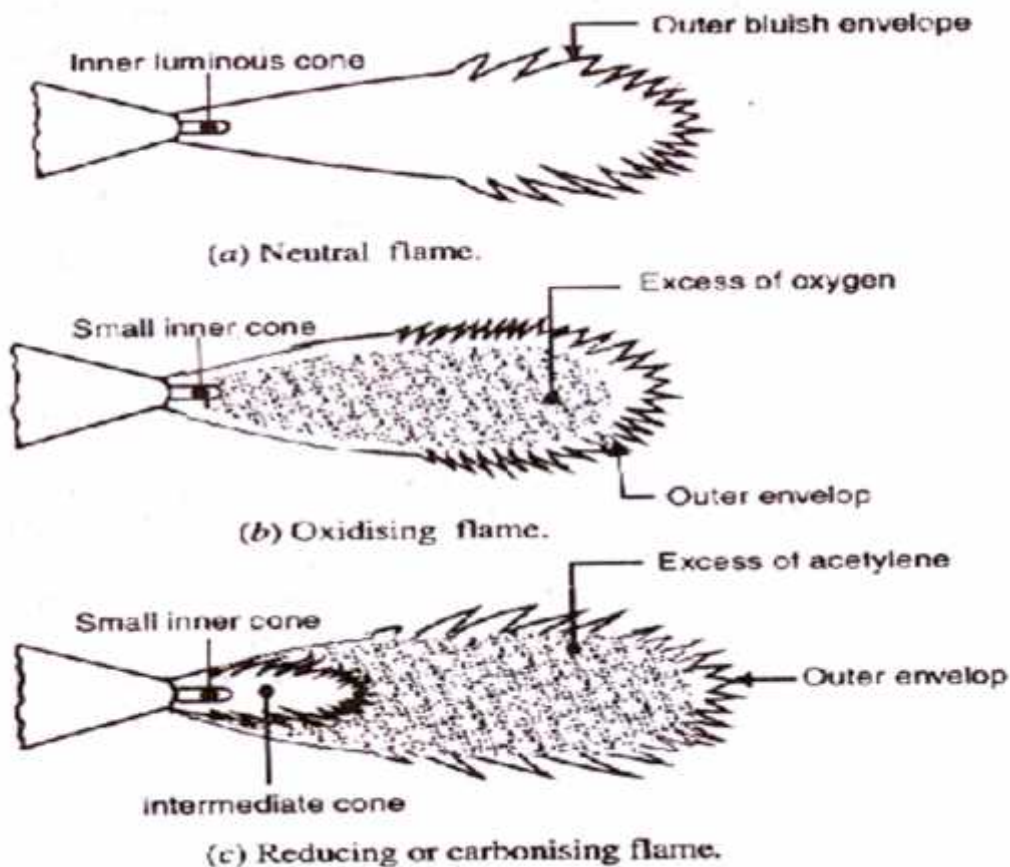


Fig. 15.30. Types of flames.

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Shielded metal arc welding

Shielded metal arc welding (SMAW), also known as manual metal arc (MMA) welding or informally as stick welding, is a manual [arc welding](#) process that uses a consumable [electrode](#) coated in [flux](#) to lay the weld. An [electric current](#), in the form of either [alternating current](#) or [direct current](#) from a [welding power supply](#), is used to form an [electric arc](#) between the electrode and the [metals](#) to be joined. As the weld is laid, the flux coating of the electrode disintegrates, giving off vapors that serve as a [shielding gas](#) and providing a layer of slag, both of which protect the weld area from atmospheric contamination.

ARC WELDING EQUIPMENTS:



SMAW system setup

Shielded metal arc welding equipment typically consists of a constant current [welding power supply](#) and an [electrode](#), with an electrode holder, a work clamp, and welding cables (also known as welding leads) connecting the two.

The most commonly used equipment for arc welding consist of following.

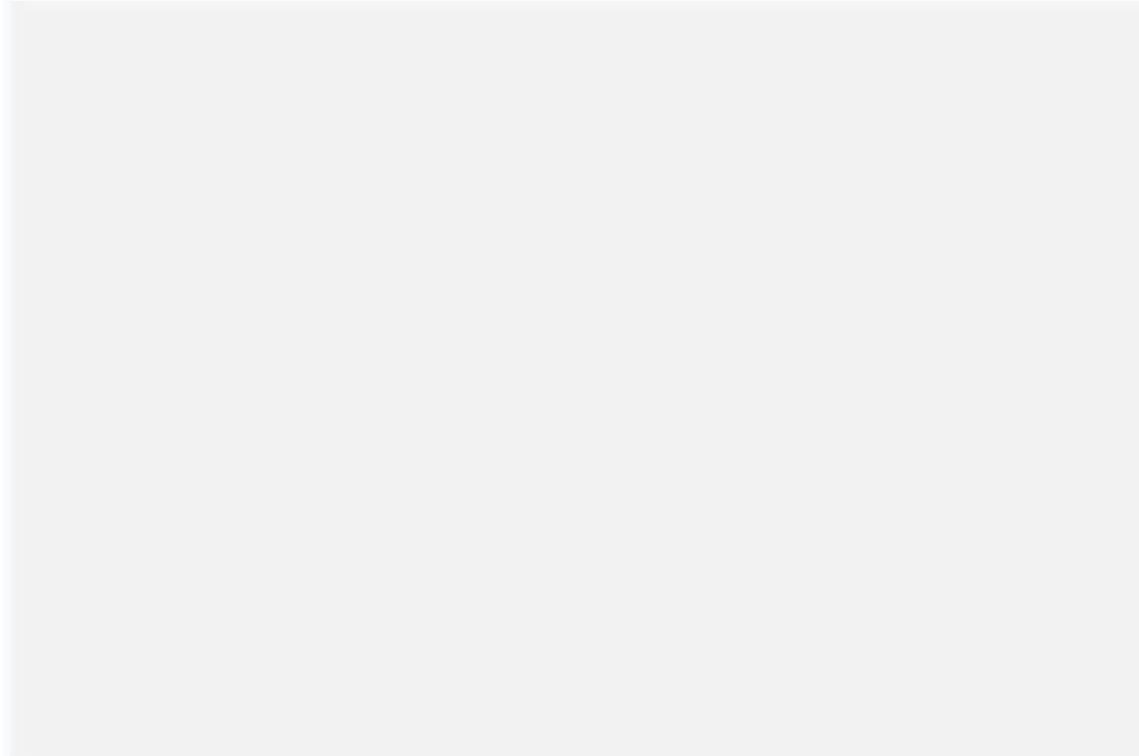
1. AC or DC machines
2. Electrodes
3. Electrodes
4. cables, cable connections
5. cable leg
6. chipping hammer
7. Earthing clamps
8. Wire brush

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- 10 Safety goggles
- 11 hand gloves
- 12 aprons sleeves

Operation



The actual welding technique utilized depends on the electrode, the composition of the work piece, and the position of the joint being welded. The choice of electrode and welding position also determine the welding speed. Flat welds require the least operator skill, and can be done with electrodes that melt quickly but solidify slowly. This permits higher welding speeds. Sloped, vertical or upside-down welding requires more operator skill, and often necessitates the use of an electrode that solidifies quickly to prevent the molten metal from flowing out of the weld pool. However, this generally means that the electrode melts less quickly, thus increasing the time required to lay the weld.

Application

Shielded metal arc welding is one of world's most popular welding processes, accounting for over half of all welding in some countries. Because of its versatility and simplicity, it is particularly dominant in the maintenance and repair industry, and is heavily used in the construction of steel structures and in industrial fabrication. In recent years its use has declined as [flux-cored arc welding](#) has expanded in the construction industry and [gas metal arc welding](#) has become more popular in industrial environments. However, because of the low equipment cost and wide applicability, the process will likely remain popular, especially among amateurs and small businesses where specialized welding processes are uneconomical and unnecessary. MAW is often used to weld [carbon steel](#), low and high [alloy steel](#), [stainless steel](#), [cast iron](#), and [ductile iron](#). While less popular for [nonferrous](#) materials, it can be used on [nickel](#) and [copper](#) and their alloys and, in rare cases, on [aluminum](#).

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COMPARISON BETWEEN A.C. and. ARC WELDING

Following is the comparison between a.c. D.C. arcs welding.

A.C. arc welding	D.C. arc welding
1 the a.c. welding transformer has no moving parts and is simpler.	1. The D.C. welding generator has rotating parts and is more complicated.
2. The transformer costs less and its maintenance cost is low.	2. the generator costs more and its maintenance cost is high
3. Since the distribution of heat is equal, there fore there is no need for changing the polarity. Hence only ferrous metal are usually welded by a.c	3. Heat distributions different in two poles,i.e.,two-third in positive and one third in negative. By changing the polarity all types of metals can be welded by D.C.
4. All types of electrodes can not be used in a.c. arc welding because the current constantly reverses with every cycle. Only coated electrodes can be used	4 all types of electrodes bare or coated can be used in D.C. arc welding because the polarity can be changed to suit the electrode.
5. The problem of arc blow does not arise as it is very easy to control.	5.in D.C.the arc blow is severe and cannot be controlled easily
6the arc is never stable.	6the arc is more stable
7. It can be used only when A.C.supply from the mains is available.	7. In the absence of A.C.mains supply an engine driven D.C. generator set can be used.
8.A.C.is more dangerous	8. D.C. is comparatively less dangerous.

ELECTRODES:

Electrodes used in aw process are classified as (a) consumable (b) non consumable

(a)**consumable electrodes:** it provides the source of the filler metal in arc welding. These electrodes are available in two forms rods and wire. Welding rods are typically of 225mm to450mm in length and 9.5mm or less in diameter.probleme with consumable welding rods, at least in production welding operations is that they be changed periodically, reducing arc time of the welder . Consumable weld wire has the advantages that it can be continuously fed into the weld pool from spools containing long lengths wire, thus avoiding the frequent interruptions that occur when using welding stick. In both and wire forms the electrode is consumed by the arc during the welding process and added the weld joint as filler metal.

(b) **Non consumable electrodes:-**They are made of tungsten or carbon, which resists melting by arc despite its name a consumables electrode, is gradually depleted during the welding process, analogous to the gradual wearing of a cutting tool in a machining operation. For AW process that

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utilizes non consumable electrodes any filler metal used in the ceratiopn must be supplied by means of a separate wire that is fed into the weld pool.

WELDING POSITIONS

The welding positions are classified as follows:

1. Flat position. In this position, the filler metal is deposited from the upper side of the joint with the face of the weld horizontal as shown in fig.
2. Horizontal position. In this position the weld is deposited upon the side of a horizontal and against a vertical surface as shown in fig (b)
3. Vertical position. IN this position the line of welding is in a vertical plane and the weld is deposited upon a vertical surface as shown in fig15.6(c)

TYPES OF WELDED JOINTS



Common welding joint types – (1) Square butt joint, (2) Single-V preparation joint, (3) Lap joint, (4) T-joint.

The relative positions of the two pieces being joined determine the types of joint. The following are the five basic types of joints commonly used in fusion welding.

1. LAP JOINTS. The lap joint is obtained by over lapping the plates and then welding the edges of the plates. These joints are employed on plates having thickness less than 3mm. the lap joints may be (a) Single transverse (b) double transverse and (c) parallel lap joints. The lap joints are shown in fig.15.1 a single transverse lap joints has the disadvantages that the edge of the plate which is not welded can buckle or out of shape.

2. BUTT JOINT. The butt joint is obtained by welding the ends or edges of the two plates which are approximately in the same plane with each other shown .In butt welds, the plates edges do not require beveling if the thickness of plates is less than 5mm. On the other hand, if the plates thickness is 5mm to 12.5mm, the edges should be beveled to form a V-groove and plates having thickness above 12.5mm should have a V or U-groove on both sides. The butt joints may be (a) Square butt joints, (b)

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single v-butt joints, (c) double v-butt joints (d) single-butt joints and (e) double-butt joints. These joints are shown in

3. CORNER JOINT. The corner joints as shown in fig.15.3 (a) are obtained by joining the edges of two plates whose surfaces are at an angle of approximately 90 to each other. It is used for both light and heavy gauge sheet metal .in some cases corner joint can be welded without any filler metal, by melting off the edges of parent metal.

4. EDGE JOINTS. the edge joint as, shown in fig.15.3 (b) is obtained by joining two parallel plates. it is economical for plates having thickness less than 6mm.this joints is unsuitable for members subjected to direct tension or bending.

5.T-JOINT .The T-joint as, shown in fig15.3(c)is obtained by obtained by joining two plates whose surfaces are approximately at right angle to each other . It is widely used to weld stiffeners in air craft and other thin walled structures, these joints are suitable upto3mm thickness.

Fillet welded joints

The lap joints, corner joints and t-joints are the fillet welded connections which are generally used. The rounding of a corner is known as filleting. The cross section of the fillet is approximately triangular.

WELDING DEFECTS:

S.NO.	DEFECTS	REASONS
1	Undercut: undercut is like a small notch in the weld interface.	Improper welding technique, excessive welding current, incomplete manipulation of the electrode while depositing the bead.
2	Incomplete fusion; incomplete fusion is a discontinuity in the weld zone.	Improper penetration of the joint, incorrect welding technique, wrong design.
3	Porosity: porosity in large quantity would reduce the strength of the joint.	Porosity in welding is caused by the presence of gases which get entrapped during the solidification processes.
4	Slag inclusion: slag is formed by the reaction with the fluxes and is generally lighter. It would be the chipped off after solidification.	Rapid solidification, insufficient welding heat, improper manipulation of the electrode, high viscosity of weld metal.
5	Hot cracking: hot cracking occurs at high temperature and the size can be very small to be visible.	Less cross-section area of the root bead.
6	Cold cracking: cold cracking generally occurs at room temperature after the weld is completely cooled.	Excessive restraint of the joint which induces very high residual stresses.

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Experiment no. 3.1

Object:- To making a lap joint by gas welding

Tool Equipment: -welding torch, oxygen,fitting regulator ,welding goggles, welding rod gas lighter, acetylene cylinder

Material: m.s.flat

Procedure: collect tools &material from work shop store

1. procedure tow flat piece of mild steel of required dims ions

Clean welding area.

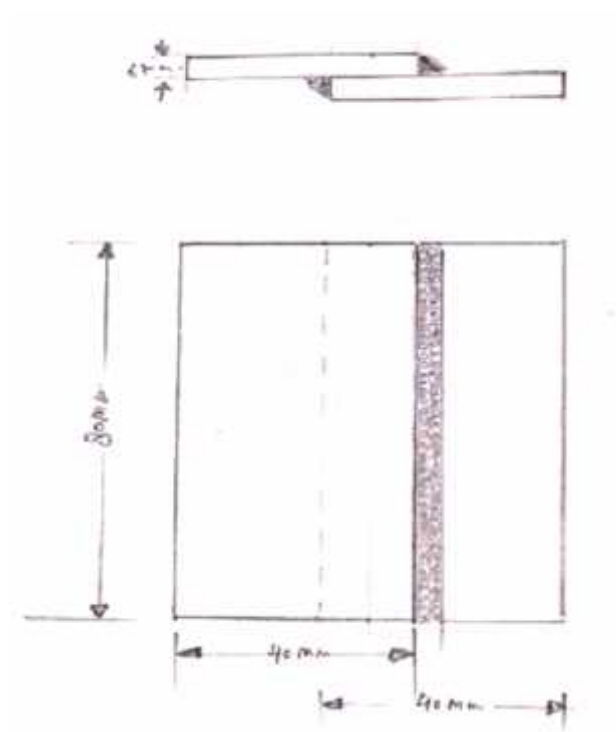
2. place piece on welding table
3. turn on acetylene gas knob and light it
4. turn on oxygen knob so that natural flame can be obtained for welding
5. hold welding torch in one hand and welding rod in the other hand
6. heat the job at the corners and make teak welding on both side
7. start job frame one end complete it on other end
8. allow weld to cool
9. inspect weld reweld if it is necessary

Result:- lap joint as per given dimension has been made

Precautions:

1. Heavy gloves are to be worn
2. Hand shield or welding goggle should be used to protect face and eyes
3. During gas welding acetylene cylinder pressure should with in limit other wise it may explote
4. Always close the valve before moving cylinder or when in finished.

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TOLERANCE : (+2,-2MM)

MATERIAL: M.S.FLAT

Experiment no. 3.2

Object:-To perform butt joint on a given work piece as per given dimensions by using electric arc welding .

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Tools and Materials:-Mild steel flat, AC Transformer, cables, cable connector, Earthing Plate, electrode holder, electrode, apron , Welding goggle, leather gloves, chipping hammer, chisel, Wire brush.

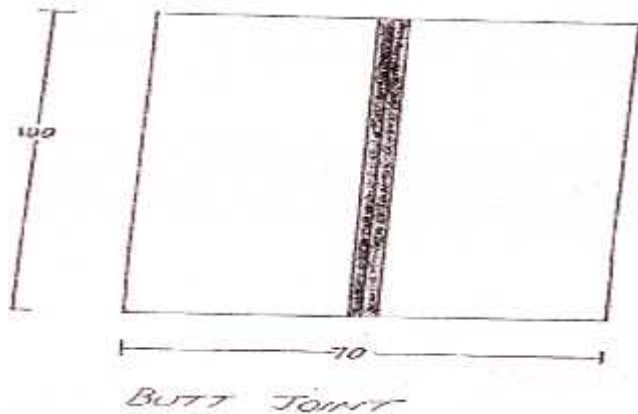
Procedure:

Collect tools and material from workshop store. Check work piece for correct dimension, if not bring the dimension within limit by filing. Remove rust from all the surfaces by filing. Make one edge of both work pieces V shape by filing. Now take the work pieces to the welding shop. Keep both work pieces by joining V edges on earthing plate. With the help of welding equipments join both the ends. Allow the joint to cool and then remove flux coating and chips by chipping hammer. Clean the surface by wire brush.

Result:-Butt joint as per given dimensions has been made.

Safety Precautions:

1. Heavy leather gloves are to be worn.
2. A hand shield or Welding goggle should be used to protect the face and eyes.
3. An apron should be worn to safeguard the operator's clothes.
4. The space for electric arc Welding should be screened off from rest of the building to safeguard their workmen from glare of the arc.
5. During gas welding acetylene cylinder pressure should within limit otherwise it may explode.
6. Always close the valve before moving cylinder or when work is finished



Experiment no. 3.3

Object:-To make lap joint on a given work piece as per given dimensions

Tools and Materials:-Mild steel flat, AC Transformer, cables, cable connector, Earthing Plate, electrode holder, electrode, apron , Welding goggle, leather gloves, chipping hammer, chisel, Wire brush

Procedure:

Collect tools and material from workshop store. Check work piece for correct dimension, if not bring the dimension within limit by filing. Remove rust from all the surfaces by filing. Make one edge v

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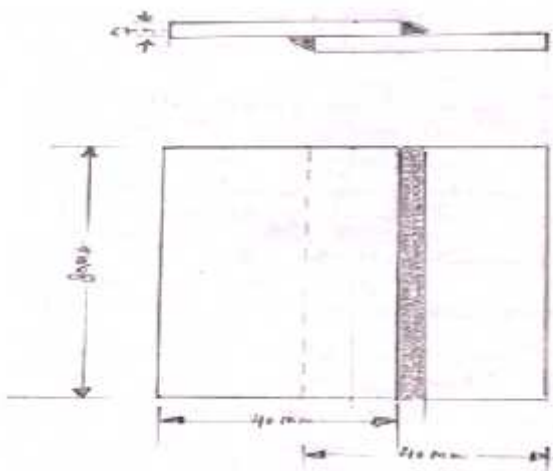
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shape by filling, scribe the lines on work piece as per given dimensions. With the help of welding equipments make lap joint. Allow the joint to cool and then remove flux coating and chips by chipping hammer. Clean the surface by wire brush.

Result:-Lap joint as per given dimensions has been made.

Safety Precautions:

1. Heavy leather gloves are to be worn.
2. A hand shield or Welding goggle should be used to protect the face and eyes.
3. An apron should be worn to safeguard the operator's clothes.
4. The space for electric arc Welding should be screened off from rest of the building to safeguard their workmen from glare of the arc.
5. During gas welding acetylene cylinder pressure should within limit otherwise it may explode.
6. Always close the valve before moving cylinder or when work is finished.



FITTING SHOP

FILES

A file is a hardened piece of high grade steel with slanting rows of teeth it is used to cut smooth or fit metal parts. It cuts all metals except hardened steel and it cuts only on forward stroke. The teeth are cut on blades which are hardened, tempered. The tang is tempered to make it soft and tough.

CLASSIFICATIONS:-

Files are classified according to size, cut, teeth, grade shape or cross section of file as discussed.

Size of file. :-length of the file in general use is 200mm to 450mm and 100mm to 200mm for finer work.

Cut of teeth:-the files according to the cut of teeth are divided into two groups single double cut.

In single cut files teeth are parallel to each other to each running across faces angle of 60 degree to the centre line.

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In double cut file there are two sets of sets of teeth the first set of teeth are similar to those of single cut files while the second set of teeth are cut diagonally across first set of teeth an angle of 80 degree to centre line.

Grade of file:-the single cut and double cut files depending upon pitch of the teeth may be classified as rough ,bastard ,second cut,smooth,deadsmooth,super fine .

Shape of file according to file:

Flat file: flat file is parallel for about two thirds of its length and then tapers in width thickness.

Hand file: hand file has its width parallel throughout but its thickness tapers .both faces are double cut one edge single cut.

Square file: A square file is parallel for two thirds of its length then tapers towards tip.it is double cut on all sides and is used for filling square corners .

Pillar file: A pillar file is similar to hand file but is narrower thicker than hand file it has one or both or uncut edges.

Triangular file: A triangular file has width either parallel through or unto middle &than tapered of the tip. its cross section is triangular and three faces are double cut &edges single cut.

Round file: round file has round cross section .a file with width parallel thought is called round parallel &file with parallel up to middle and then tapering towards tip is called rat file.

Half round: the section of half round file is not a true half circle but is only about one third of circle. Width of the file is either parallel thought or unto middle and then tapered towards tip.

Knife edge file: A knife edge file has a width tapered like a knife blade. It is also tapered towards tip thickness. it is double cut on both flat faces and single cut on both edges.

Warding file: warding file is similar to flat file but it is thinner and parallel on its thickness. It is used for filing narrow slots.

Mill file: A mill file is similar to flat but parallel on both width thickness and have both edges round.

Needle file: The needle file is available in size from 100mm to 200mm of various shapes &cuts.

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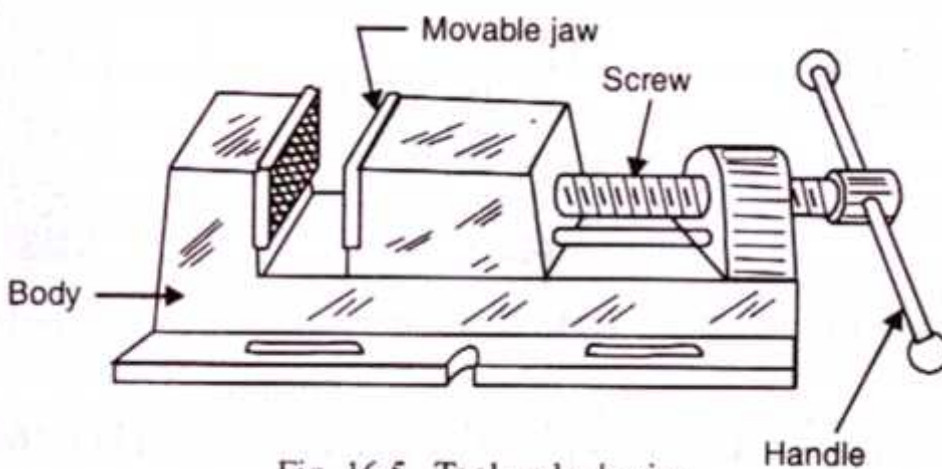
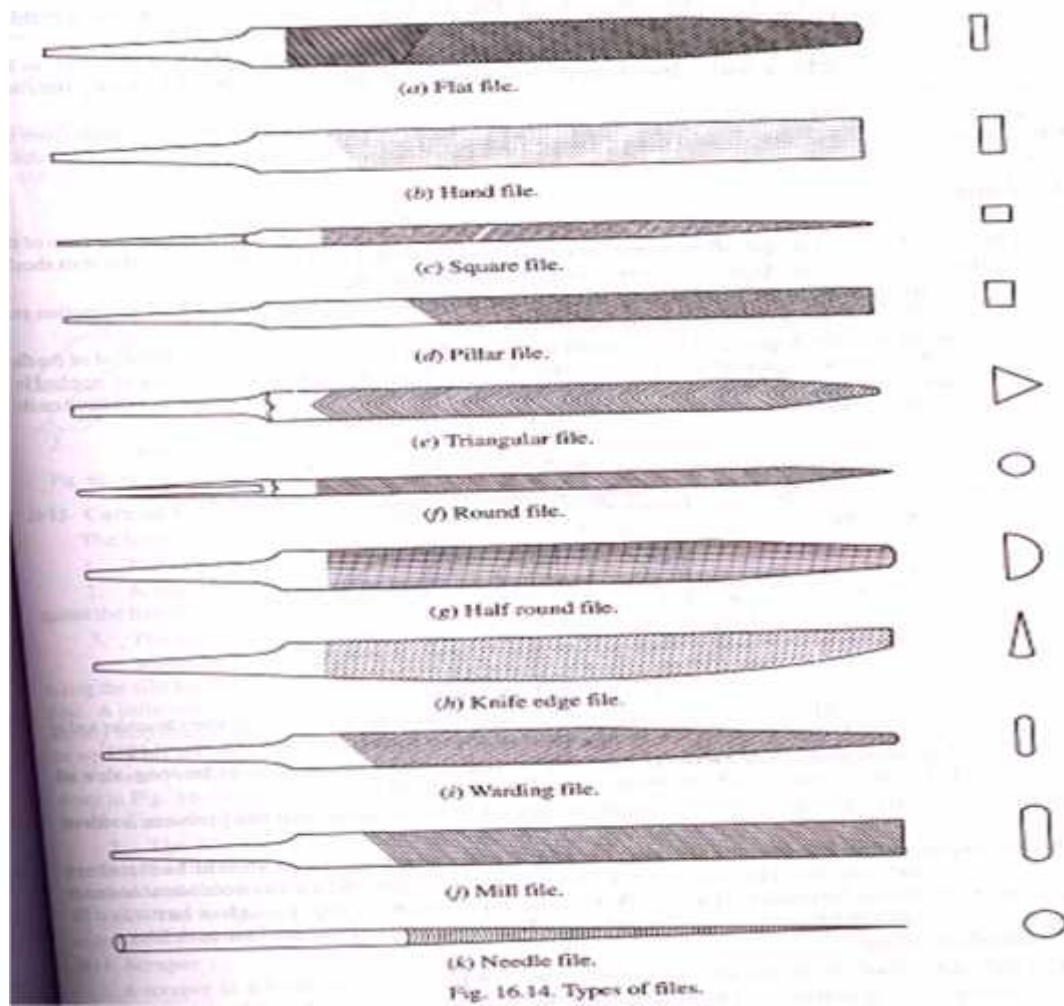
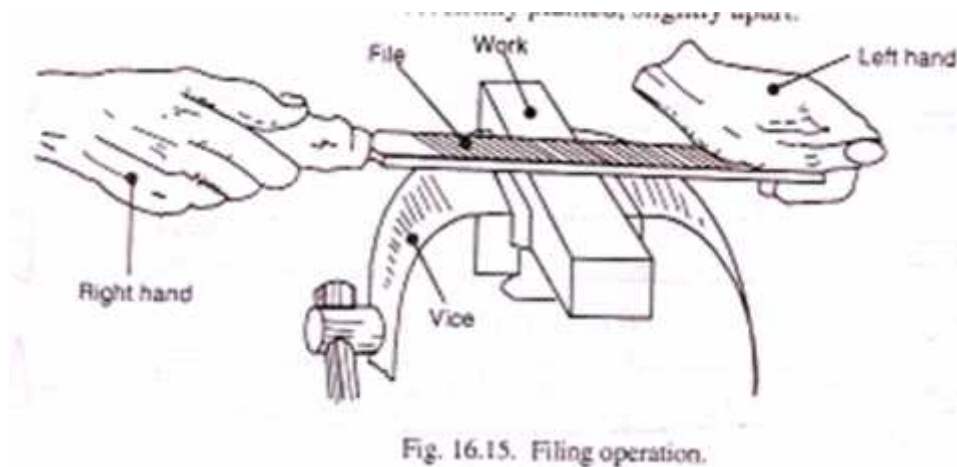


Fig. 16.5. Tool maker's vice.

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Experiment No. 4.1

Object: - Describe the procedure to produce a job in fitting shop

1. Finishing of two side of a square piece by filling
2. To cut a square using hacksaw.
3. Drill three holes on p.c.d and tapping

Tools & Equipments:

Bench vice surface plate steel scale scribe try square hand neck saw, flat file square file, and drilling m/c drill bit, taps

Material: MS flat

Procedure:

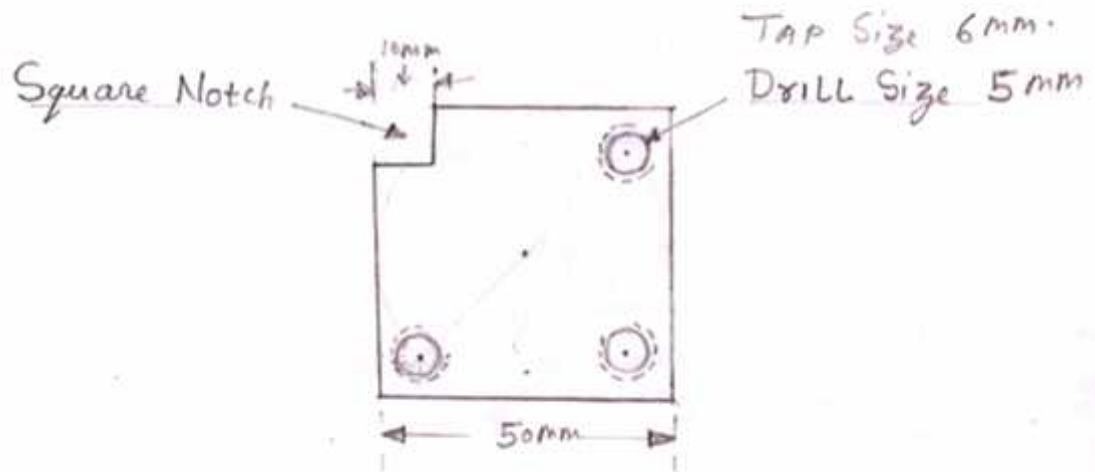
1. Collect tools and material from work shop store
2. Check work piece for correct dimensions
3. Hold the work piece in bench vice
4. Remove the burs from edges by filling
5. Squareness & flatness checking by try square
6. Cut the square notch by hand hacksaw
7. Square notch filling by square file
8. Square & flatness of the square notch checking by try square
9. Marked p.c.d. of work piece & put center punch mark on pcd in put
10. Drill three hole on p.c.d. by drilling m/c
11. Do tapping in the drilled holes

Results: -Two side filling, square notch cutting, three holes drilling & tapping operations has been done.

Precaution:

1. The work piece should be hold sight in vice
2. The files should move horizontally

4. Tools should be kept in a proper case
5. Do not drop the tools
6. After finishing work tools should be cleaned properly



Experiment no.4.2

Object: To making a ring /link in machine joint and soldering of joint.

Tools & equipments: tongs, hammer, scale, anvil, chisel, gas burner etc.

Material: MS rod

Procedure:

1. Collect tools & material from work shop store
2. Cut rod in it two or three piece of req. size
3. Heat one piece of rod in a forge fire
4. Place it with round tong over horn of an anvil and bend it by hammering with hand hammer
5. Lab the ends of bar
6. Heat the job to welding tem. (1275 to 1400 degree cel.) Steel and light press the joint area with hammer.
7. Apply borax and repeat job
8. Take out the job make joint properly
9. Finish the job check the round of ring as well as the built joint

Result: make a ring/with mechanical joint as per given dimension given has been made.

Precautions:

1. Carefully handle the heated store
2. For bending forge welding do not use heavy hammer
3. Please to be welded must be absolutely clean
4. Weld area must be properly heated thoroughly hammered

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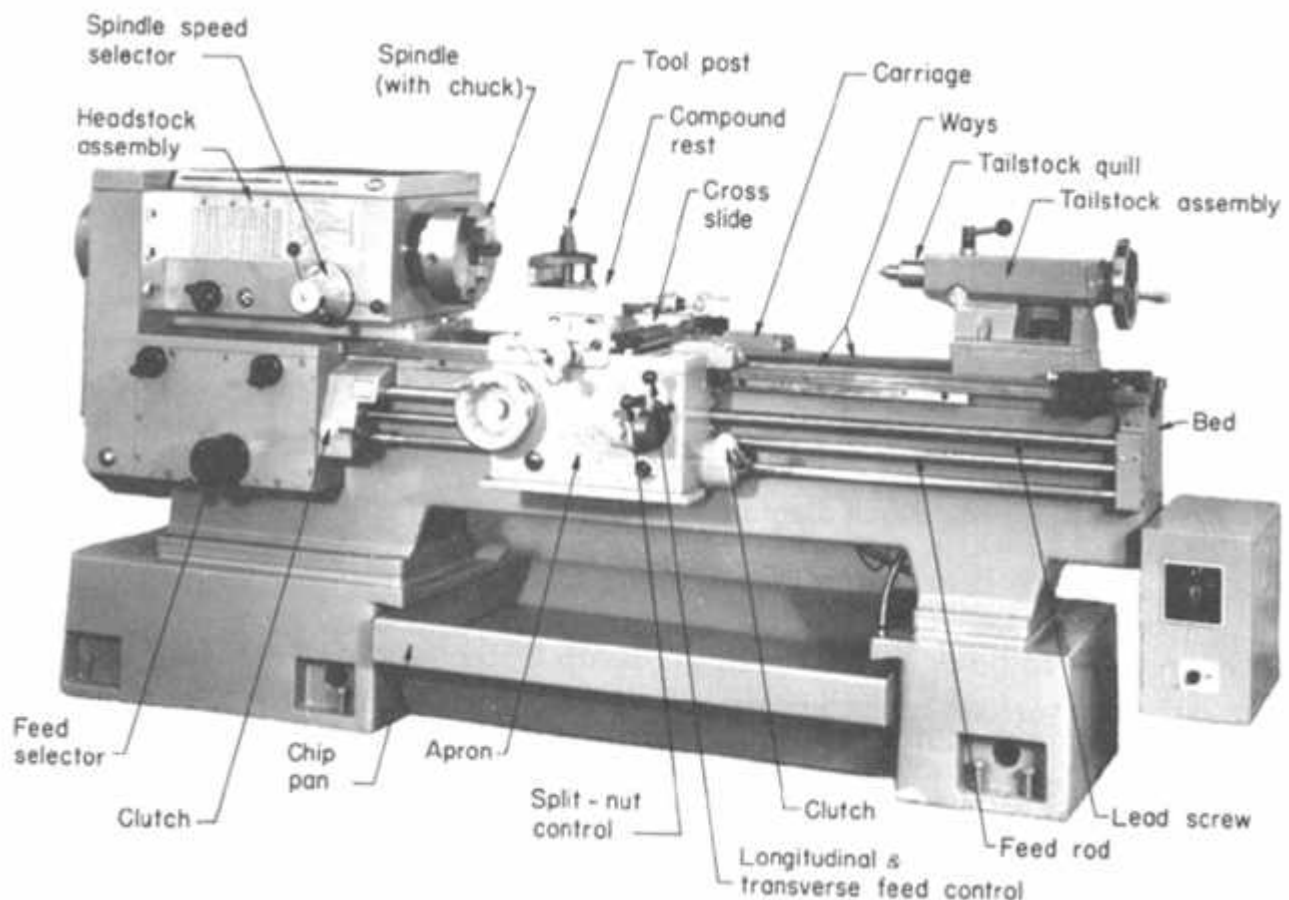


Machine shop

Lathe

A **lathe** ([pronounced](#) is a [machine tool](#) which spins a block of material to perform various operations such as [cutting](#), [sanding](#), [knurling](#), [drilling](#), or [deformation](#) with tools that are applied to the workpiece to create an object which has [symmetry](#) about an [axis of rotation](#).

Lathes are used in [woodturning](#), [metalworking](#), [metal spinning](#), and glassworking. Lathes can be used to shape [pottery](#), the most well known design being the [potter's wheel](#). Most suitably equipped metalworking lathes can also be used to produce most [solids of revolution](#), plane surfaces and screw threads or helices



Experiment no.5

Object: -To perform step turning and chamfering operation on lathe m/c as per drawing.

Tools & materials: - Lathe m/c single point cutting tool, steel rule, outside caliper, tool.

Materials: -MS rod.

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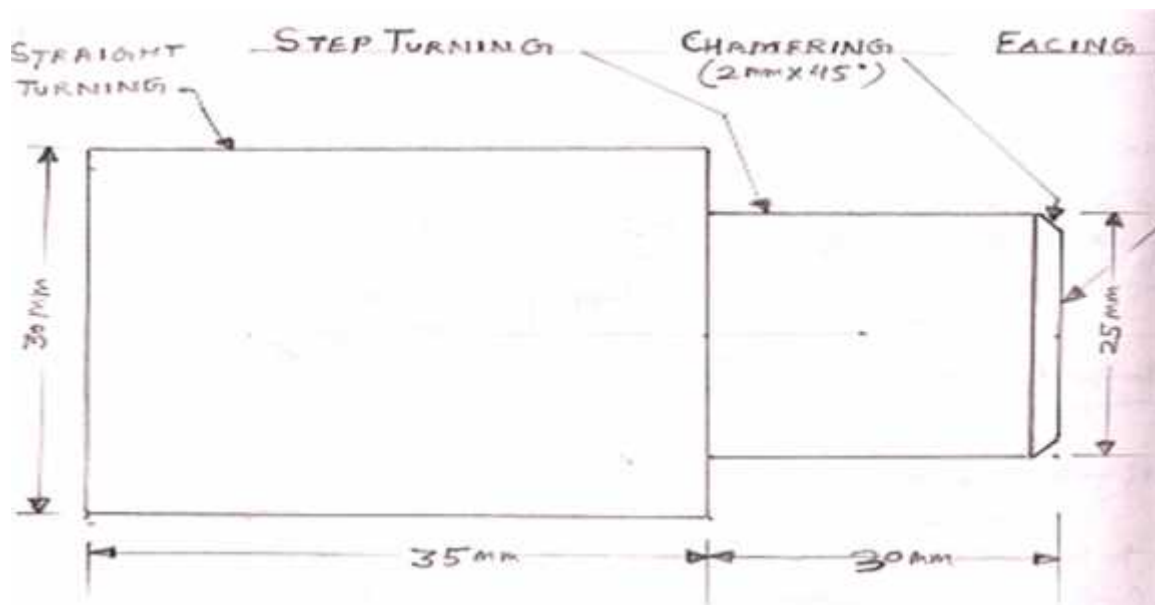
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1. Collect tools material from work shop store check for measurement
2. Hold the work piece in self centering chuck 20mm set single point cutting tool in the tool post (angle 45 degree)
3. Select and set m/c at proper speed feed for facing operation.
4. For straight turning operation set tool at straight to your position lock it touch tool to work piece.
5. Give depth of cut division on cross wheel.
6. Start m/c and with help of longitude wheel
7. To cutting operation again give feed and cutting operation till required diameter of job.
8. Set single point cutting tool for chamfering
9. Unclamp work piece from chuck
10. Hold the work piece back side in chuck select and set tool proper operation for operation step turning,
11. Check dimension as per drawing and finish the job.

Result: -Step turning & chamfering operation as per given dimension has been done

Precaution: -

1. Chuck key in not to be left in the chuck after tightening job
2. Keep yourself away from revolting parts
3. Safety general should be on
4. Do not leave m/c unattended in running condition.



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Lab Manual

Title of Course: Language Lab-II

Course Code: HU281

L-T-P scheme: 0-0-2

Course Credit: 2

Objectives:

1. This Course has been designed to impart advanced skills of Technical Communication in English through Language Lab. Practice Sessions to 1ST Semester UG students of Engineering & Technology.
2. To enable them to communicate confidently and competently in English Language in all spheres.

Learning Outcomes:

1. This course will help the students to learn English very easily. Even the Hindi medium students can translate easily.
2. The technical communication will help the students to improve their speaking skills and drafting skill for engineering students.

Course Contents:

Exercises that must be done in this course are listed below:

Exercise No.1: Phonetic symbols and transcription.

Exercise No. 2: Honing 'Listening Skill' and its sub skills through Language Lab Audio device;

Exercise No. 3: Honing 'Speaking Skill' and its sub skills;

Exercise No. 4: master Linguistic/Paralinguistic features (Pronunciation/Phonetics/Voice modulation/

Stress/ Intonation/ Pitch Accent) of connected speech;

Exercise No. 5: Honing 'Conversation Skill' using Language Lab Audio –Visual input;

Conversational Practice Sessions (Facet Face/ via Telephone, Mobile phone & Role Play Mode);

Exercise No. 6: Introducing 'Group Discussion' through audio –Visual input and acquainting them with key strategies for success;

Exercise No. 7: G D Practice Sessions for helping them internalize basic Principles (turn-taking, creative intervention, by using correct body language, courtesies& other soft skills) of GD;

Exercise No. 8: Honing 'Reading Skills' and its sub skills using Visual/ Graphics/Diagrams /Chart Display/Technical/Non Technical Passages; Learning Global/ Contextual/ Inferential Comprehension;

Exercise No. 9: Honing 'Writing Skill' and its sub skills by using Language Lab Audio –Visual input;

Practice Sessions

Exercise No. 10: Group discussion

Text Book:

1. Phonetic Symbol Guide Book by Geoffrey K. Pullum.
2. Dr.D.Sudharani: Manual for English Language Laboratory Pearson Education (WB edition),2010
3. Board of Editors: Contemporary Communicative English for Technical Communication Pearson Longman, 2010