Scheme – I

Sample Question Paper

Program Name	: Diploma in Electronics Engineering Program Group	
Program Code	: EJ/DE/ET/EN/EX/EQ	
Semester	: Second	
Course Title	: Electronic Engineering Materials	
Marks	: 70	Time: 3 Hrs.

Instructions:

(1) All questions are compulsory.

(2) Illustrate your answers with neat sketches wherever necessary.

(3) Figures to the right indicate full marks.

(4) Assume suitable data if necessary.

(5) Preferably, write the answers in sequential order.

Q.1 Attempt any FIVE of the following.   **10 Marks**

    a) List any two applications of secondary emission.

    b) List any two dielectric properties of polymeric material.

    c) List any two magnetic materials.

    d) Draw energy level diagram of conductor and insulator.

    e) Define superconductivity.

    f) List any two trivalent and any two pentavalant impurity materials

    g) Give the relevant combination of materials for LED to emit red and green color.

Q.2 Attempt any THREE   **12 Marks**

    a) Explain thermoelectric effect and give its any two application.

    b) Explain the concept of ferroelectricity and state its anyone application.

    c) Describe the breakdown in solid dielectric materials.

    d) Explain the process of photoelectric emission.

Q3. Attempt any THREE   **12 Marks**

    a) Explain the process of diffusion in semiconductor material.

    b) Identify the material offering higher resistivity from following fig. no.1

Fig.no.1

   c) Suggest the relevant materials used in flexible and wearable antenna.

d) Differentiate between anti-ferromagnetism and ferrimagnetisms.

Q4. Attempt any THREE   12 Marks
a) Explain the principle of stimulated emission and radiation in LASER.
b) Explain the piezoelectric effect and give any two materials which exhibit this effect.
c) Explain Magnetostriction property of ferromagnetic material.
d) Explain the effect of change in temperature on conductivity of semiconductor.
e) Explain the characteristics of good insulating material.

Q5. Attempt any TWO   12 Marks
a) Suggest the suitable material for i)Thermionic emission ii) photoelectric emission and explain any one emission process. Give one application of each.
b) Identify the material based on given Hysteresis loop in fig No.1 and fig. No 2 and describe any one.

Small

Magnetic Hysteresis Loop for Soft and Hard Ferromagnetic Materials

fig no.1   **fig.no.2**
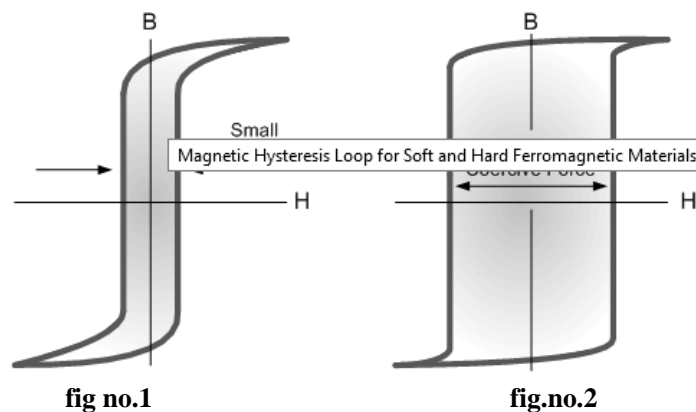
c) Write one applications for the given dielectric material
(i) Mica (ii) Porcelain (iii) Polythene (iv) Bakelite (v) Rubber (vi) cotton.

Q6. Attempt any TWO.   12 Marks
a) State any four materials used in fabrication of semiconductor device and describe its need.
b) On the basis of given properties identify the magnetic materials (i) Permanent magnetic dipole (ii) Diamagnetism(iii) Paramagnetism (iv) Ferromagnetism.
c) Describe Hall Effect and state its application.

Scheme – I

Sample Test Paper - I

Program Name	**: Diploma in Electronics Engineering Program Group**
Program Code	**: EJ/DE/ET/EN/EX/EQ**
Semester	**: Second**
Course Title	**: Electronic Engineering Materials**
Marks	**: 20**

22217

Time: 1 Hour

Instructions:

(1) All questions are compulsory.
(2) Illustrate your answers with neat sketches wherever necessary.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if necessary.
(5) Preferably, write the answers in sequential order.

Q.1. Attempt any FOUR of the following   **08 Marks**

    a) Define conductor, Insulator with examples

    b) Mention the use of dielectric materials

    c) Define the term polymerization

    d) Define Superconductivity

    e) List the different types of conducting materials

    f) Define dielectric loss

Q.2. Attempt any THREE of the following   **12 Marks**

    a) Describe the effect of temperature on superconductivity of metals

    b) Describe the breakdown in liquid dielectric materials

    c) Describe the factors affecting on Mobility

    d) Describe the different modes of emission

Scheme – I

Sample Test Paper - II

Program Name	: Diploma in Electronics Engineering Program Group	
Program Code	: EJ/DE/ET/EN/EX/EQ	
Semester	: Second	**22217**
Course Title	: Electronic Engineering Materials	
Marks	: 20	**Time: 1 Hour**

Instructions:
(1) All questions are compulsory.
(2) Illustrate your answers with neat sketches wherever necessary.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if necessary.
(5) Preferably, write the answers in sequential order.

Q.1. Attempt any FOUR of the following   **08 Marks**

    a) Define diamagnetic, paramagnetic and ferromagnetic.

    b) List the materials for fabrication of semiconductor devices.

    c) List different impurities used to emit different colors of light.

    d) Define diffusion.

    e) Give the classification of magnetic materials.

    f) Give different functions of antenna.

Q.2. Attempt any THREE of the following   **12 Marks**

    a) Explain electroluminescence.

    b) Sketch energy band diagrams of conductors, semiconductors.

    c) Explain the effect of thermal and electrical conductivity on semiconductor materials.

    d) Give the materials used for flexible and wearable antenna.

22217

Instructions –   (1) All Questions are *Compulsory.*

(2) Illustrate your answers with neat sketches wherever necessary.

(3) Figures to the right indicate full marks.

(4) Assume suitable data, if necessary.

(5) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1.   **Attempt any <u>FIVE</u> of the following :**   **10**

a) State the factors affecting the resistivity of metals.

b) Define piezoelectricity.

c) List any two magnetic materials.

d) List any types of semiconductors and state their applications.

e) Name any two superconductors.

f) Define drift and diffusion currents.

g) State any two photo emissive materials.

Marks

2.   Attempt any THREE of the following :   **12**

   a) Explain superconductivity, its features and applications.

   b) Explain the effects of frequency on the electronic polarizability.

   c) Describe the breakdown in gaseous dielectrics.

   d) Explain the concept of field emission.

3.   Attempt any THREE of the following :   **12**

   a) Explain the effect of temperature on the conductivity of semi-conductor.

   b) State the material used and application of micromotors.

   c) State and explain thermoelectric effects.

   d) Differentiate between anti-ferromagnetism and ferrimagnetism.

4.   Attempt any THREE of the following :   **12**

   a) State the type and concept of electroluminance of LASER.

   b) Explain the effect of a dielectric material on the behavior of a capacitor.

   c) Give the classification of magnetic materials and explain any one.

   d) Explain clearly the effect of temperature on electrical conductivity of metals.

   e) State the characteristics of good insulating materials.

Marks

5. **Attempt any TWO of the following :**   **12**

    a) Suggest the suitable material for –

       i)   Field emission

       ii)   Secondary emission and explain any one emission process. Give one application of each.

    b) Differentiate diamagnetic, paramagnetic and ferromagnetic materials. (any six points).

    c) Write one applications for the given dielectric material.

       i)   Polyvinylcarboide

       ii)   Silk

       iii)   glass

       iv)   Bakelite

       v)   Porecilan

       vi)   mica

6. **Attempt any TWO of the following :**   **12**

    a) Draw energy band diagram for semi-conductor, conductor and insulator. Explain the N-type semi-conductor.

    b) Classify the magnetic materials on the basis of presence or absence of permanent magnetic dipoles.

    c) Describe Hall effect and state its applications.

_____

22217

21222

3 Hours / 70 Marks

15 minutes extra for each hour

Seat No. ☐☐☐☐☐☐☐☐

Instructions – (1) All Questions are *Compulsory.*

(2) Illustrate your answers with neat sketches wherever necessary.

(3) Figures to the right indicate full marks.

(4) Assume suitable data, if necessary.

(5) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. **Attempt any FIVE of the following:** **10**

    a) List factors affecting resistivity of electric materials.

    b) What is piezoelectricity ?

    c) List any four dielectric materials.

    d) Define the term 'Permeability'. State its unit.

    e) List any two magnetic materials.

    f) 'Trivalent impurity materials are called as Acceptor impurity'. Justify your answer.

    g) Define Electroluminesence.

2.	**Attempt any <u>THREE</u> of the following:**

12

a) State the requirements of good insulating material.

b) Explain the concept of anti-ferromagnetism with neat diagram.

c) Sketch energy band diagram of conducting and insulating material and lable it well.

d) Explain the principle of stimulated emission and radiation in LASER.

3.　　Attempt any <u>THREE</u> of the following:　　　　**12**

a) Describe the principle of thermoelectric. State thermoelectric materials.

b) Describe dielectric strength and dielectric constant with respect to dielectric materials.

c) Explain how energy levels are formed in a material.

d) List any four photoemissive materials. State features of any one of them.

4.　　Attempt any <u>THREE</u> of the following:　　　　**12**

a) Define electron mobility. State it's significance in electronic components.

b) Explain seebeck effect and give it's two applications.

c) Explain the concept of magnetostriction effect and state it's applications.

d) Compare P-Type and N-Type semiconductor materials using following points.

    (i)　Impurities used.

    (ii)　Majority carriers.

    (iii)　Bands in which conduction takes place.

    (iv)　Minority Carriers.

e) Explain diffusion (current) in a semiconductor.

Marks

5. **Attempt any TWO of the following:** 12

a) Explain superconductivity and give any four applications of it.

b) Classify liquid dielectric material and explain breakdown in liquid dielectric materials.

c) Explain the properties of magnetic materials with examples:

(i) Ferromagnetism

(ii) Paramagnetism

(iii) Diamagnetism

6. **Attempt any TWO of the following:** 12

a) State the different modes of electron emission in metal. Explain any one mode of emission.

b) Write one application for the given dielectric materials.

(i) Mica

(ii) PVC

(iii) Polythene

(iv) Glass

(v) Rubber

(vi) Cotton

c) Draw and explain the typical magnetization curve for a ferromagnetic materials. State the applications of ferromagnetic materials.

————

11920

3 Hours / 70 Marks　　Seat No. ☐☐☐☐☐☐☐☐

Instructions :　(1)　All Questions are *compulsory.*

　　　　　　　　(2)　Illustrate your answers with neat sketches wherever necessary.

　　　　　　　　(3)　Figures to the right indicate full marks.

　　　　　　　　(4)　Assume suitable data, if necessary.

Marks

1.　**Attempt any FIVE of the following :**　　　　　　　　　　　**10**
　(a)　Define superconductivity.
　(b)　List any two examples of ferroelectric materials.
　(c)　Give classification of magnetic materials.
　(d)　Draw energy level diagram of conductor & insulator.
　(e)　List any two applications of photoelectric emission.
　(f)　List any two trivalent & pentavalent impurity materials.
　(g)　Give any two applications of micro relays.

2.　**Attempt any THREE of the following :**　　　　　　　　　**12**
　(a)　Explain how energy levels are formed in a materials.
　(b)　Explain the concept of piezo-electricity & state its any one application.
　(c)　Explain the properties of dielectric materials.
　(d)　Explain the concept of thermoelectric effect & give any two materials for thermocouples.

3.　**Attempt any THREE of the following :**　　　　　　　　　**12**
　(a)　Explain the process of photoelectric emission.
　(b)　Explain diffusion (current) in a semiconductor.
　(c)　Explain the principle of stimulated emission & radiation in LASER.
　(d)　Differentiate between anti-ferromagnetism & ferrimagnetisms.

4. **Attempt any THREE of the following :** 12

   (a) Suggest the relevant materials used in flexible & wearable antenna.

   (b) Explain the characteristics of good insulating materials.

   (c) Explain the concept of magnetostriction effect & state its application.

   (d) Suggest any one suitable material and any one application for :
      (i) thermionic emission
      (ii) secondary emission

   (e) Write one application for the given dielectric materials :
      (i) Mica
      (ii) Bakelite
      (iii) Rubber
      (iv) Polythene

5. **Attempt any TWO of the following :** 12

   (a) Explain the effect of temperature on conductivity of metals.

   (b) On the basis of given properties, identify the magnetic materials
      (i) Permanent magnetic dipole
      (ii) Diamagnetism
      (iii) Paramagnetism
      (iv) Ferromagnetism

   (c) Write one property for the given dielectric material.
      (i) Ceramic
      (ii) Porcelain
      (iii) Poly Vinyl Chloride (PVC)
      (iv) Cotton
      (v) Silk
      (vi) Glass

6. **Attempt any TWO of the following :** 12

   (a) Describe Hall effect & state its applications.

   (b) Describe the magnetization curve.

   (c) State any four materials used in fabrication of semiconductor device & describe its need.

   _____

21819

3 Hours / 70 Marks   Seat No. ☐☐☐☐☐☐☐☐

Instructions :   (1)   All Questions are *compulsory.*
(2)   Answer each next main Question on a new page.
(3)   Illustrate your answers with neat sketches wherever necessary.
(4)   Figures to the right indicate full marks.
(5)   Assume suitable data, if necessary.
(6)   Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1.   **Attempt any FIVE of the following :**   **5 × 2 = 10**
   (a)   Define Superconductivity.
   (b)   Give any two properties of polymers.
   (c)   Give the classification of magnetic materials.
   (d)   Define intrinsic and extrinsic semiconductor.
   (e)   List any two applications of thermionic emission.
   (f)   Draw energy level diagram of conductor and insulator.
   (g)   State any four applications of micrometers.

2.   **Attempt any THREE of the following :**   **3 × 4 = 12**
   (a)   Explain the concept of field emission and give its two applications.
   (b)   Explain the requirements of good insulating material.
   (c)   Explain the concept of piezo-electricity and give its two applications.
   (d)   Explain seekback effect and give its two applications.

3.   **Attempt any THREE of the following :**   **3 × 4 = 12**
   (a)   Explain types of impurity added in a semiconductor with one example each.
   (b)   Give various photoemissive materials and suggest relevant combination of material for LED to emit Yellow and Green colour.
   (c)   State and explain various factors affecting the resistivity of electrical materials.
   (d)   Explain the concept of anti-ferromagnetism.

4. **Attempt any THREE of the following :** 3 × 4 = 12
   (a) Suggest the relevant materials used in flexible and wearable antenna.
   (b) Explain the effect of a dielectric on the behaviour of a capacitor.
   (c) Explain various factors that affecting the permeability.
   (d) Explain the effect of temperature on the electrical conductivity of metal.
   (e) Describe the breakdown in solid dielectric materials.

5. **Attempt any TWO of the following :** 2 × 6 = 12
   (a) Suggest suitable material for (i) Secondary emission (ii) Photoelectric emission and explain any one emission process. Give one application of each.
   (b) State one application for the given dielectric material :
       (i) Mica
       (ii) Rubber
       (iii) Cotton
       (iv) Wood
       (v) Polythene
       (vi) Bakelite
   (c) Draw and explain the typical magnetization curve for a ferromagnetic material. State the applications of ferromagnetic materials.

6. **Attempt any TWO of the following :** 2 × 6 = 12
   (a) Explain the following in brief :
       (i) Diffusion
       (ii) Hall effect
       (iii) Thermal conductivity
   (b) Explain the properties of magnetic materials with examples :
       (i) Permanent magnetic dipole
       (ii) Paramagnetism
       (iii) Diamagnetism
   (c) Explain the following materials used for fabrication of semiconductors :
       (i) Substrata
       (ii) Capacitance materials
       (iii) Metals

_____

11819

3 Hours / 70 Marks   Seat No. ☐☐☐☐☐☐☐☐

Instructions :   (1)   All Questions are *compulsory.*

(2)   Illustrate your answers with neat sketches wherever necessary.

(3)   Figures to the right indicate full marks.

(4)   Assume suitable data, if necessary.

(5)   Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1.   Attempt any FIVE :   **2 × 5 = 10**

(a)   Define resistivity. State its unit.

(b)   State any four dielectric materials.

(c)   State the classification of magnetic material.

(d)   Define intrinsic and extrinsic semiconductor.

(e)   Define Thermonic emission.

(f)   State the impurities for obtaining p-type and n-type semiconductor from intrinsic semi conductor. (2 each)

(g)   Give the material composition for obtaining RED and yellow colour LED.

2. **Attempt any THREE :** 4 × 3 = 12

    (a)   Describe super conductivity. State its applications.

    (b)   Describe the concept of piezo electricity and state its applications.

    (c)   State the requirements of good insultating material.

    (d)   Describe the effects of temperature on conductivity of metals.

3. **Attempt any THREE :** 4 × 3 = 12

    (a)   State the materials used for fabrication of photo diode along with its justification.

    (b)   Describe the process of photo emission. State the application of photo emission in electronic components.

    (c)   Describe the principle of thermoelectric. State thermoelectric materials.

    (d)   Draw and explain hysteresis loop in magnetic material.

4. **Attempt any THREE :** 4 × 3 = 12

    (a)   Write one application for the given dielectric material.

        (i)   Polyvinyl Carbide (PVC)

        (ii)   Glass

        (iii)   Mica

        (iv)   Cotton and silk

(b)   Explain the materials used in wearable antennas with their properties.

(c)   Describe dielectric strength and dielectric constant with respect to dielectric materials.

(d)   Explain the concept of anti ferro magnetism and state its significance.

(e)   Define Electron mobility. State its significance in electronic components.

5.   **Attempt any TWO :**   6 × 2 = 12

(a)   State the different modes of electron emission in metal. Explain any two modes of emission.

(b)   Define magnetic permeability. State and explain the factors affecting permeability of magnetic materials.

(c)   Describe the concept of ferro electricity. Explain the application of ferro electric material.

6.   **Attempt any TWO :**   6 × 2 = 12

(a)   (i)   Explain the process of diffusion in semiconductor material.

      (ii)   Explain Hall effect.

(b)   Explain magnetostriction property. Explain generation of ultrasonic using magnetostriction.

(c)   State any four materials used in fabrication of semiconductor device and describe its need.

————————————

21718

3 Hours / 70 Marks   Seat No.

Instructions : (1) All Questions are *compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1. **Attempt any FIVE of the following :**   **10**

(a) Define the term 'Photoelectric emission'.

(b) List dielectric materials (any four).

(c) Define the term 'Permeability'. State its unit.

(d) Sketch energy band diagram of intrinsic semiconductor.

(e) List electrical conducting material (any four).

(f) 'Pentavalent impurity materials are called as Donor impurity.' Justify your answer.

(g) State working principle of LED.

2. **Attempt any THREE :** 12

   (a) State the effect of following factors on resistivity of electrical conducting material :

   (i) Temperature

   (ii) Alloying

   (iii) Cold work

   (iv) Age Hardening

   (b) State four selection factors for selecting an insulating material.

   (c) Describe the effect on the capacitance of the dielectric material on the basis of factors polarizability and permittivity.

   (d) Describe Peltier thermoelectric effect. State its application.

3. **Attempt any THREE :** 12

   (a) Compare P-type semiconductor with N-type semiconductor on the basis of

   (i) Majority charge carrier

   (ii) Minority charge carrier

   (iii) Impurity material

   (iv) Fermi-level position in energy band diagram.

   (b) List specifications of micro relay. (any four)

   (c) Sketch energy band diagram of conducting and insulating material and label it well.

   (d) Sketch orientation of spins in paramagnetic, ferromagnetic, anti-ferromagnetic and ferrimagnetic material.

4. **Attempt any THREE :** 12

   (a) State any two characteristics of

       (i) Electro-textile

       (ii) Textile-antenna

       used for wearable antenna.

   (b) Describe the concept of ferroelectricity. State its applications.

   (c) Describe with sketch B-H curve. State effect of change in temperature on area of B-H curve.

   (d) State effect of temperature on superconductivity of metals.

   (e) State any **two** properties and application of following material :

       (i) Mica

       (ii) Transformer oil

       (iii) Rubber

       (iv) Polymer

5. **Attempt any TWO :** 12

   (a) The resistivity of pure copper is 1.56 $\mu\Omega$-cm. An alloy of copper containing 1 atomic percent nickel has a resistivity of 2.81 $\mu\Omega$-cm. An alloy of copper containing 3 atomic percent silver has a resistivity of 1.98 $\mu\Omega$-cm. Calculate the resistivity of copper alloy containing 2 atomic percent nickel and 2 atomic percent silver.

    (b)   Classify following material as diamagnetic, paramagnetic, ferromagnetic and anti-ferromagnetic :

        (i)   Platinum

        (ii)   Iron

        (iii) Glass

        (iv) Nickel oxide

        (v)   Quartz

        (vi) Silicon Iron alloy

    (c)   Describe effect of plate area, thickness of dielectric material, permittivity on capacitance of a capacitor.

6. **Attempt any TWO :**   **12**

    (a)   Explain thermal conductivity and coefficient of thermal conductivity in semiconductor material.

    (b)   Explain hysteresis loss and eddy current loss of magnetic material.

    (c)   Suggest two passive materials used for substrate, metal and capacitance of semiconductor device fabrication. State their two functions.

_____

17216

Instructions – (1) All Questions are *Compulsory*.

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1.   **Attempt any TEN of the following:**   **20**

a) Find x and y if $x(1-i) + y(2+i) + 6 = 0$

b) Express in $a + ib$ form $\dfrac{2 - \sqrt{3}\,i}{1 + i}$

c) If $f(x) = x^2 - 2x + 5$ and $t = y - 2$, find $f(t)$.

d) If $f(x) = \log_a^x$, prove that $f(m) + f(n) = f(m.n)$

e) Evaluate $\displaystyle \lim_{x \to -4} \frac{x^2 + 3x - 4}{x^2 + 7x + 12}$

f) Evaluate $\displaystyle \lim_{x \to 0} \frac{4x - \tan x}{3x + \tan x}$

P.T.O.

Marks

g) Evaluate $\displaystyle\lim_{x \to 0} \left(\frac{e^{3x} - 1}{4x} \right)$

h) Find $\dfrac{dy}{dx}$, if $y = \log[\tan(4 - 3x)]$

i) Find $\dfrac{dy}{dx}$, if $x = a(\theta - \sin\theta)$, $y = a(1 - \cos\theta)$

j) Differentiate $\cos^{-1}(1 - 2\sin^2 x)$

k) Show that there exist a root of the equation $x^3 + 2x^2 - 8 = 0$ between 1 and 2.

l) Solve the following equations by using Gauss-Seidal method (only first iteration)

$10x + 2y + z = 9$; $x + 10y - z = -22$; $-2x + 3y + 10z = 22$

2.   **Attempt any FOUR of the following:**   **16**

a) Simplify using De-Moiver's theorem

$$\frac{(\cos\theta - i\sin\theta)^6 \ (\cos 5\theta - i\sin 5\theta)^{-2}}{(\cos 8\theta + i\sin 8\theta)\frac{1}{2}}$$

b) Find cube root of unity.

c) If $x + iy = \sin(A + iB)$, prove that $\dfrac{x^2}{\cos h^2 \text{ B}} + \dfrac{y^2}{\sin h^2 \text{ B}} = 1$

d) Prove that $(1 + \cos\theta + i\sin\theta)^n + (1 + \cos\theta - i\sin\theta)^n$

$$= 2^{n+1} \cdot \cos^n\left(\frac{\theta}{2}\right) \cdot \cos\left(\frac{n\theta}{2}\right)$$

e) If $f(x) = \dfrac{2x + 5}{3x - 4}$ and $t = \dfrac{5 + 4x}{3x - 2}$ show that $f(t) = x$

f) If $f(x) = \log\left(\dfrac{1 + x}{1 - x}\right)$, show that $f(a) + f(b) = f\left(\dfrac{a + b}{1 + ab}\right)$

Marks

3. **Attempt any FOUR of the following:** **16**

a) If $f(x) = \log\left(\frac{x}{x-1}\right)$, show that $f(a+1) + f(a) = \log\left(\frac{a+1}{a-1}\right)$

b) If $f(x) = x - \frac{1}{x}$, then prove that $[f(x)]^3 = f(x^3) + 3f\left(\frac{1}{x}\right)$

c) Evaluate $\displaystyle\lim_{x \to 0} \left(\frac{\sqrt{1+x} - \sqrt{1-x}}{x}\right)$

d) Evaluate $\displaystyle\lim_{x \to \pi/4} \left(\frac{2 - \sec^2 x}{1 - \tan x}\right)$

e) Evaluate $\displaystyle\lim_{x \to 0} \left(\frac{6^x - 2^x - 3^x + 1}{x^2}\right)$

f) Evaluate $\displaystyle\lim_{x \to 5} \left(\frac{\log x - \log 5}{x - 5}\right)$

4. **Attempt any FOUR of the following:** **16**

a) Using first principal find the derivative of $\sin x$

b) Find $\frac{dy}{dx}$ if $x = a(\cos\theta + \theta\sin\theta)$ and $y = a(\sin\theta - \theta\cos\theta)$

c) Find $\frac{dy}{dx}$ if $y = \sin^{-1}\left(\frac{\cos x + \sin x}{\sqrt{2}}\right)$

d) If $e^y = y^x$, prove that $\frac{dy}{dx} = \frac{(\log y)^2}{(\log y - 1)}$

e) If $y = (\sin x)^{\log x}$, find $\frac{dy}{dx}$.

f) If $x^3 + y^3 = 3axy$, find $\frac{dy}{dx}$ at the point $\left(\frac{3a}{2}, \frac{3a}{2}\right)$

Marks

5. **Attempt any FOUR of the following:** 16

a) Evaluate $\lim\limits_{x \to \infty} \left(\dfrac{1 + 3x}{3x - 2} \right)^{2x}$

b) Evaluate $\lim\limits_{x \to a} \left(\dfrac{\cos x - \cos a}{\sqrt{x} - \sqrt{a}} \right)$

c) Using Bisection method find the approximate root of $x^3 - x - 4 = 0$ (Three iterations only)

d) Using Regula-Falsi method, find approximate root of $x^3 - 9x + 1 = 0$ (Three iterations only)

e) Solve by Newton-Raphson method $x^3 + 2x - 20 = 0$ (Three iterations only)

f) Find approximate value of $\sqrt[3]{100}$ by using Newton-Raphson method (Three iterations only)

6. **Attempt any FOUR of the following:** 16

a) Differentiate $\cos^{-1}\left(2x\sqrt{1 - x2}\right)$ w.r.to $\sec^{-1}\left(\dfrac{1}{\sqrt{1 - x2}}\right)$.

b) If $y = A\cos(\log x) + B\sin(\log x)$, prove that

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

c) Solve by Gauss-elimination method
$x + 2y + 3z = 14, \ 3x + y + 2z = 11, \ 2x + 3y + z = 11$

d) Solve by Jacobi's method
$10x + y + 2z = 13, \ 3x + 10y + z = 14, \ 2x + 3y + 10z = 15$
(Three iterations only)

e) Solve by using Gauss-Seidal method
$6x + y + z = 105, \ 4x + 8y + 3z = 155, \ 5x + 4y - 10z = 65$
(Two iterations only)

f) Solve by Gauss-Seidal method
$x + 7y - 3z = -22, \ 5x - 2y + 3z = 18, \ 2x - y + 6z = 22$
(Two iterations only)

———————

16172

3 Hours / 100 Marks   Seat No.

Instructions – (1) All Questions are *Compulsory*.

(2) Answer each next main Question on a new page.

(3) Figures to the right indicate full marks.

(4) Use of Non-programmable Electronic Pocket Calculator is permissible.

(5) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1.   **Solve any TEN of the following:**   **20**

a)   Find the value of: $i^{20} + i^{30} + i^{40} + i^{50}$

b)   Express: $(2 + 3i)(1 - 4i)$ in the form $a + ib$

c)   Find 'a' if $f(x) = ax + 10$ and $f(1) = 13$.

d)   Define: Even and odd function.

e)   Evaluate: $\displaystyle \lim_{x \to 3} \frac{\sqrt{x} + \sqrt{3}}{x + 3}$

f)   Evaluate: $\displaystyle \lim_{x \to 0} x.\operatorname{cosec} x$

g)   Evaluate: $\displaystyle \lim_{x \to 0} \frac{a^x + b^x - 2}{x}$

h)   Evaluate: $\displaystyle \lim_{x \to 0} \frac{\log(1 + 5x)}{x}$

i)   If $y = 2e^{3x} + \tan x - \cos 2x + 9\sin^{-1} x$, find $\dfrac{dy}{dx}$.

j) If $y = \dfrac{\log x}{x}$, find $\dfrac{dy}{dx}$.

k) Differentiate $7x^5 - 11x^2$ w.r.t. $7x^2 - 15x$.

l) Differentiate w.r.t. x : $\tan^{-1}\left(\dfrac{2x}{1-x^2}\right)$

m) Prove that the root of the equation $x^3 - x - 4 = 0$ lies between 0 and 2.

n) Find the first iteration by using Jacobi's method for the following system of equations:

$10x + y + 2z = 13, \ 3x + 10y + z = 14, \ 2x + 3y + 10z = 15$

2. **Solve any FOUR of the following:** **16**

a) If $f(x) = ax^2 + bx + 2$ and $f(1) = 3, \ f(4) = 42$, find a and b.

b) If $f(x) = \dfrac{2x+3}{3x-2}$, Prove that $f\left[f(x)\right] = x$

c) Separate into real and imaginary parts of:

$\dfrac{2+i}{(3-i)(1+2i)}$

d) Solve: $(4 - 5i)x + (2 + 3i)y = 10 - 7i$

e) Simplify: $\dfrac{(\cos 3\theta + i\sin 3\theta)^4 (\cos 4\theta - i\sin 4\theta)^5}{(\cos 4\theta + i\sin 4\theta)^3 (\cos 5\theta + i\sin 5\theta)^{-4}}$

f) Find all the cube roots of (-1)

3. **Solve any FOUR of the following:** **16**

a) If $f(x) = \log[1 + \tan x]$, show that $f\left(\frac{\pi}{4} - x\right) = \log 2 - f(x)$.

b) If $f(x) = x^2 - 3x + 4$ then solve: $f(1 - x) = f(2x + 1)$

c) Evaluate: $\displaystyle \lim_{x \to 5} \dfrac{x^2 - 9x + 20}{x^2 - 6x + 5}$

d) Evaluate: $\displaystyle \lim_{x \to 3} \dfrac{\sqrt{x^2 + 1} - \sqrt{10}}{x - 3}$

Marks

e) Evaluate: $\lim\limits_{x \to a} \dfrac{\sin x - \sin a}{x - a}$

f) Evaluate: $\lim\limits_{x \to 0} \dfrac{15^x - 5^x - 3^x + 1}{x . \sin x}$

4. Solve any <u>FOUR</u> of the following: **16**

a) Differentiate w.r.t. $x : x^{\sin 2x}$

b) If $x = 3 \cos\theta - \cos 3\theta,\ y = 3 \sin\theta - \sin 3\theta$ then find dy/dx.

c) Differentiate w.r.t. $x\ (\tan x)^x$.

d) Differentiate $x^{\sin^{-1}x}$ w.r.t. $\sin^{-1}x$.

e) If $xy = \log(xy)$ show that $\dfrac{dy}{dx} = -\dfrac{y}{x}$

f) If U and V are differentiable functions of x and $y = u + v$ then prove that: $\dfrac{dy}{dx} = \dfrac{du}{dx} + \dfrac{dv}{dx}$.

5. Solve any <u>FOUR</u> of the following: **16**

a) Evaluate: $\lim\limits_{x \to 0} \dfrac{\log(2 + x) - \log(2 - x)}{x}$

b) Show that the roots of the equation $x^3 - 9x + 1 = 0$ lies between 2 and 3. Obtain the roots by Bisection method. (3 iterations only)

c) Using Newton–Raphson method, Evaluate: $\sqrt[3]{100}$ (Upto three iterations only)

d) Using Regula – Falsi method, find the root of $xe^x - 3 = 0$ (three iterations only)

e) Using Bisection method, find the approximate root of $x^3 - 2x - 5 = 0$ in the interval (2, 3) (3 iterations only)

f) Find the roots of the equation using Newton–Raphson method $x^2 - 4x - 6 = 0$ near to 5. (three iterations only)

6. **Solve any FOUR of the following:** 16

a) Solve by Gauss Elimination method:

$x + y + z = 6,\ 3x - y + 3z = 10,\ 5x + 5y - 4z = 3$

b) By using first principle, prove that:

$\dfrac{d}{dx}(\sin x) = \cos x.$

c) Solve by Jacobi's method upto 3 iterations only:

$30x + y + z = 32,\ x + 30y + z = 32,\ x + y + 30z = 32$

d) Solve by Gauss–seidal method (3 iterations only)

$6x + y + z = 105,\ 4x + 8y + 3z = 155,\ 5x + 4y - 10z = 65$

e) Solve by Gauss Elimination method:

$x + y + z = 4,\ 2x + y + z = 5,\ 3x + 2y + z = 7$

f) Solve by Jacobi's method:

$4x + y + 2z = 12,\ -x + 11y + 4z = 33,\ 2x - 3y + 8z = 20$

(3 iterations only)

————

21718

3 Hours / 100 Marks   Seat No.

Instructions – (1) All Questions are *Compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1.   **Attempt any TEN of the following:**   **20**

a) Find x and y if $x(1-i) + y(2+i) + 6 = 0$

b) Define composite function.

c) If $f(x) = x^4 - 2x + 7$ find $f(0) + f(2)$

d) Express in the form of $a + ib$ if $z = \dfrac{1+i}{3-i}$

e) Evaluate $\displaystyle\lim_{x \to 4} \dfrac{2-\sqrt{x}}{4-x}$

f) Evaluate $\displaystyle\lim_{x \to 0} \dfrac{5\sin x + 7x}{8x - 3\tan x}$

g) Evaluate $\displaystyle\lim_{x \to \infty} \left(1 - \dfrac{7}{2}x\right)^x$

h) If $y = \log(1 + x^2)$ Find $\dfrac{dy}{dx}$

i) Find dy/dx if $y = \dfrac{\sin x}{1 + \cos x}$

j) Find dy/dx if $x^3 + y^3 = 3axy$

k) Using Gauss seidal method find first iteration for the system of equations:

$$8x + 2y + 3z = 30$$
$$x - 9y + 2z = 1$$
$$2x + 3y + 6z = 31$$

l) Show that the root of the equation $xe^x - 3 = 0$ lies in the interval $(1, \ 2)$.

2. **Attempt any FOUR of the following:** **16**

a) Find modulus and argument of $-3 + 3i$.

b) Using De-Movier's Theorem, simplify,

$$\frac{(\cos \theta - l\sin \theta)^5 (\cos 3\theta + l\sin 3\theta)^{-4}}{(\cos 3\theta + l\sin 3\theta)^{-2} (\cos 5\theta - l\sin 5\theta)^3}$$

c) Find all required roots of $(-1)^{1/5}$ using De-Movier's Theorem.

d) If $\cos(A + l\,B) = x + l\,y$ show that $\dfrac{x^2}{\cos^2 A} - \dfrac{y^2}{\sin^2 A} = 1$ and

$$\frac{x^2}{\cos h^2 B} + \frac{y^2}{\sin h^2 B} = 1$$

e) If $f(x) = y = \dfrac{ax + 1}{5x - a}$ show that $f(y) = x$.

f) If $f(x) = \log\left(\dfrac{x - 1}{x}\right)$, show that $f(y^2) = f(y) + f(-y)$

Marks

3.   **Attempt any FOUR of the following:**   16

a) If $f(x) = \dfrac{x-1}{x+1}$, $x \ne -1$, show that $f\left(\dfrac{x-1}{x+1}\right) = \dfrac{-1}{x}$

b) For what values of x, $f(x) = f(2x+1)$ if $f(x) = x^2 - 3x + 4$

c) Evaluate $\displaystyle\lim_{x \to 3} \left[\dfrac{1}{x-3} - \dfrac{1}{(x^2 - 5x + 6)}\right]$

d) Evaluate $\displaystyle\lim_{x \to \infty} x\left[\sqrt{x^2 + 1} - \sqrt{x^2 - 1}\right]$

e) Evaluate $\displaystyle\lim_{x \to 0} \dfrac{\cos 3x - \cos 5x}{x^2}$

f) Evaluate $\displaystyle\lim_{x \to 0} \dfrac{10^x - 2^x - 5^x + 1}{x \tan x}$

4.   **Attempt any FOUR of the following:**   16

a) Using First principle of derivative, find the derivative of log x.

b) If u and v are differentiable functions of x and $y = {}^{u}\!/\!_{v}$ then

$$\dfrac{dy}{dx} = \dfrac{V\dfrac{du}{dx} - U\dfrac{dv}{dx}}{V^2}$$

c) If $y = \dfrac{e^x - e^{-x}}{e^x + e^{-x}}$ then show that $\dfrac{dy}{dx} = 1 - y^2$

d) If $y = \tan^{-1}\left[\dfrac{\sin 2x}{1 - \cos 2x}\right]$ Find $\dfrac{dy}{dx}$

e) Find derivative of $(\sin^{-1}x)^{\cos x}$

f) Differentiate $5^{\sqrt{x}}$ w.r.t. to $\left(\sqrt{x}\right)^x$

Marks

5.   Attempt any **FOUR** of the following: 16

a) Evaluate $\displaystyle \lim_{x \to 0} \frac{\log(e + x) - 1}{x}$

b) Evaluate $\displaystyle \lim_{x \to 0} \frac{\sin 3x + 7x}{4x + \sin 2x}$

c) Using Bisection method find the approximate root of the equation $x^3 - 6x + 3 = 0$ (Perform three iterations)

d) Use Regular falsi method to find approximate root of the equation $x^3 - x - 4 = 0$ (Three iterations)

e) Use Newton Raphson method to evaluate $\sqrt[3]{20}$ (upto three iterations only)

f) Using Bisection method find the root of the equation $x^3 - 4x - 9$ in the interval (2, 3).

6.   Attempt any **FOUR** of the following: 16

a) If $y = 2\sin 2x - 5\cos 2x,$ show that $\dfrac{d^2 y}{dx^2} + 4y = 0$

b) If $y = \log(\log x)$ prove that

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

c) Using Gauss elimination method, solve the equation:

   $2x + 3y + 2z = 2$

   $10x + 3y + 4z = 16$

   $3x + 6y + z = -6$

d) Using Jacobi's method, solve the system of equations:

   $10x + 2y + z = 9; \ 2x + 20y - 2z = -44; -2x + 3y + 10z = 22$

   (Perform three iterations).

e) Using Gauss-seidal method, solve the equations:

   $5x - y = 9; \ x - 5y + z = -4; \ y - 5z = 15$ (Perform three iterations)

f) Using Jacobi's method, solve the equations

   $2x + 3y - 4z = 1 \ , \ 5x + 9y + 3z = 17 \ ; \ 8x - 2y - z = 5$

   (Perform three iterations)

———

11819

3 Hours / 100 Marks   Seat No. ☐☐☐☐☐☐☐☐

Instructions – (1) All Questions are *Compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1.   **Solve any TEN of the following:**   **20**

a)   State whether the function is even or odd

if $f(x) = \dfrac{a^x + a^{-x}}{2}$

b)   If $f(x) = x^2 \dfrac{1}{x^2}$

show that, $f(x) + f(-x) = 2\ f(x)$

c)   Seperate into real and immaginary part for, $\sin(x + iy)$

d)   If $(3 + i)x + (1 - i)y = 1 + 7i$, find x and y.

e)   Evaluate $\displaystyle\lim_{x \to 1} \dfrac{x^2 - 1}{x - 1}$

f)   Evaluate $\displaystyle\lim_{x \to 0} \left[\dfrac{5\tan x + 6x}{9x - 2\sin x} \right]$

P.T.O.

Marks

g) Evaluate $\displaystyle \lim_{x \to 0} \frac{a^x - b^x}{x}$

h) If $y = x \cdot \log x$ find $\dfrac{dy}{dx}$

i) If $y = \cos(\log x)$ find $\dfrac{dy}{dx}$

j) Differentiate $\sin x$ w.r.t. 'log x'

k) From the following system of Equations,

$3x + 2y = 4.5, \ 2x + 3y - z = 5, \ -y + 2z = 0.52$

Find one iteration only using Gauss-Seidal method.

l) Show that the root of the equation $x^3 - 9x + 1 = 0$ lies bet^n 2 and 3.

2. **Solve any FOUR of the following:** **16**

a) Express $\dfrac{1}{2} + i\dfrac{\sqrt{3}}{2}$ in polar form.

b) Simplify using De Moivre's theorem

$$\frac{\left[\cos \frac{4}{3}\theta + i\sin \frac{4}{3}\theta\right]^3 \cdot \left[\cos \frac{1}{2}\theta - i\sin \frac{1}{2}\theta\right]^2}{\left[\cos 4\theta - i\sin 4\theta\right] \cdot \left[\cos 2\theta + i\sin 2\theta\right]^3}$$

c) By using De Moivre's theorem find "cube root of unity".

d) Show that $\sin 2\theta = 2\sin \theta \cdot \cos \theta$ using Euler's form.

e) If $f(x) = 50 \sin[100\pi x + 0.4]$, prove that $f\left[\dfrac{1}{50} + x\right] = f(x)$

f) If $f(x) = \dfrac{x+3}{4x-5}$ and $t = \dfrac{3+5x}{4x-1}$

show that $f(t) = x$

3. **Solve any FOUR of the following:** **16**

a) If $f(x) = x^2 + 5$, find x if $f(x+2) = f(x-2)$

b) If $f(x) = 16^x + \log_2 x$ find $f\left(\dfrac{1}{4}\right)$

Marks

c) Evaluate $\lim\limits_{x \to 0} \dfrac{\sin 2x^0}{x}$

d) Evaluate $\lim\limits_{x \to 0} \dfrac{\sqrt{1+x} - \sqrt{1-x}}{x}$

e) Evaluate $\lim\limits_{x \to 0} \dfrac{12^x - 4^x - 3^x + 1}{x^2}$

f) Evaluate $\lim\limits_{x \to \infty} \left[\dfrac{x+1}{x+2}\right]^x$

4. Solve any **FOUR** of the following: 16

a) Using 1st principle of derivatives find derivatives of $f(x) = \log x$

b) If u and v are differentiable functions of x, then prove that
$$\frac{d}{dx}[U.V] = u\frac{dv}{dx} + v\frac{du}{dx}$$

c) Find $\dfrac{dy}{dx}$ if $y = x^x + a^x$

d) Find $\dfrac{dy}{dx}$ if $y = \log\left[x^2 - 2x + \sin x\right]$

e) Find $\dfrac{dy}{dx}$ if $y = \tan^{-1}\left[x \middle/ \left(1 + 12x^2\right)\right]$

f) Find $\dfrac{dy}{dx}$ if $x^2 + y^2 = 4xy$

5. Solve any **FOUR** of the following: 16

a) Evaluate $\lim\limits_{x \to 0} \dfrac{\log(a+x) - \log a}{x}$

b) Evaluate $\lim\limits_{x \to 0} \dfrac{3\sin x - \sin 3x}{x^3}$

c) Using bisection method find approximate root of the equation
$x^3 - 4x - 9 = 0$

d) Find approximate root of equation, $x \cdot \log_e x = 1.2$ by using bisection method.

e) Find root of the equation $x^2 + x - 3 = 0$ using Regula Falsi method.

f) Use Newton-Raphson method to find root of equation $x^2 + x - 3 = 0$ (upto three iterations)

6.   **Solve any <u>FOUR</u> of the following:**   **16**

a) If $y = 2\cos[\log x] + 3\sin[\log x]$ prove that $x^2 \dfrac{d^2y}{dx^2} + x \cdot \dfrac{dy}{dx} + y = 0$

b) If $x = a[\theta - \sin\theta]$ and $y = a[1 - \cos\theta]$ find $\dfrac{dy}{dx}$ and $\dfrac{d^2y}{dx^2}$ at $\theta = \pi/4$

c) Solve the following equations by Gauss elimination method.

$4x + y + 2z = 12, \ -x + 11y + 4z = 33, \ 2x - 3y + 8z = 20$

d) Solve the following equation by using Jacobi's method,

$20x + y - 2z = 17, \ 3x + 20y - z + 18 = 0, \ 2x - 3y + 20z = 25$

e) Solve the following equation by using Gauss elimination method.

$2x + 3y + z = 13, \ x - y - 2z + 1 = 0, \ 3x + y + 4z = 15$

f) Solve the following equation using Gauss Seidal method.

$10x + y + z = 12, \ x + 10y + z = 12, \ x + y + 10z = 12$

_____

21819

3 Hours / 100 Marks   Seat No.

Instructions – (1) All Questions are *Compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1.   **Solve any TEN of the following:**   **20**

a) Find x and y if $x(1-i)+y(2+i)+6=0$.

b) If $Z = 1+i\sqrt{3}$ show that $Z^2+4=2Z$

c) If $f(x)=x^3-3x^2+5$, find $f(0)+f(2)$.

d) If $f(x)=\log(\tan x)$, find $f\left(\pi/4\right)$

e) Evaluate : $\displaystyle\lim_{x\to 1}\left(\frac{1}{x-1}-\frac{1}{x^2-x}\right)$

f) Evaluate : $\displaystyle\lim_{x\to 0}\frac{\sin 2x}{x}$

g) Evaluate : $\displaystyle\lim_{x\to 0}\frac{e^{3x}-1}{2x}$

P.T.O.

Marks

h) If $y = a^{2x} \cos(3x)$, find $\dfrac{dy}{dx}$

i) If $y = \log[\tan(4 - 3x)]$ find $\dfrac{dy}{dx}$

j) If $\tan^{-1}(x^2 + y^2) = a^2$ find $\dfrac{dy}{dx}$

k) Show that there exist a root of the equation $x^3 - 4x + 1 = 0$ in the interval (1, 2)

l) Find by Jacobi's method, the first iteration only for the following equations $5x - y = 9$, $x - 5y + z = -4$, $y - 5z = 6$

2. **Solve any FOUR of the following:** **16**

a) Express $\left(-\dfrac{1}{2} + \dfrac{\sqrt{3}}{2}i\right)$ in Polar form.

b) Simplify using De–Moiver's theorem,

$$\dfrac{(\cos 3\theta + i \sin 3\theta)^4 (\cos 4\theta - i \sin 4\theta)^5}{(\cos 4\theta + i \sin 4\theta)^3 (\cos 5\theta + i \sin 5\theta)^4}$$

c) Using Euler's formula, prove that $\cos 2\theta = \cos^2 \theta - \sin^2 \theta$

d) Prove that :

$$(1 + \cos\theta + i\sin\theta)^n + (1 + \cos\theta - i\sin\theta)^n = 2^{n+1} \cdot \cos^n\left(\theta/2\right) \cdot \cos\left(\dfrac{n\theta}{2}\right)$$

e) If $f(x) = \dfrac{2x + 5}{3x - 4}$ and $t = \dfrac{5 + 4x}{3x - 2}$, show that $f(t) = x$

f) If $f(x) = \log\left(\dfrac{1 + x}{1 - x}\right)$ then, prove that $f\left(\dfrac{2x}{1 + x^2}\right) = 2 \cdot f(x)$

Marks

3.   **Solve any FOUR of the following:**   **16**

   a) If $f(x) = x^2 - 4x + 11$, solve the equation $f(x) = f(3x - 1)$

   b) If $f(t) = 50\sin(100\pi t + 0.04)$ show that $f\left(\dfrac{2}{100} + t\right) = f(t)$

   c) Evaluate : $\displaystyle\lim_{x \to 4} \dfrac{x^4 - 64x}{\sqrt{x^2 + 9} - 5}$

   d) Evaluate : $\displaystyle\lim_{x \to \infty} \left(\sqrt{x^2 + x} - x\right)$

   e) Evaluate : $\displaystyle\lim_{x \to 0} \dfrac{5^x + 5^{-x} - 2}{x^2}$

   f) Evaluate : $\displaystyle\lim_{x \to 0} \left(\dfrac{2x + 1}{1 - 2x}\right)^{1/x}$

4.   **Solve any FOUR of the following:**   **16**

   a) Using first principle find derivative of $f(x) = \log x$

   b) If u and v are differentiable functions of x and $y = \dfrac{u}{v}$,

       then prove that $\dfrac{dy}{dx} = \dfrac{v\dfrac{du}{dx} - u\dfrac{dv}{dx}}{v^2}$

   c) If $e^y = y^x$ prove that $\dfrac{dy}{dx} = \dfrac{(\log y)^2}{\log y - 1}$

   d) If $x^3 + y^3 = 3axy$, find $\dfrac{dy}{dx}$ at the point $\left(\dfrac{3a}{2}, \dfrac{3a}{2}\right)$

   e) If $x = 3\sin\theta - 2\sin^3\theta$, $y = 3\cos\theta - 2\cos^3\theta$ find $\dfrac{dy}{dx}$ at $\theta = \dfrac{\pi}{4}$

   f) Differentiate $\tan^{-1}\left(\dfrac{2x}{1 - x^2}\right)$ w.r.t. $\sin^{-1}\left(\dfrac{2x}{1 + x^2}\right)$

Marks

5.   **Solve any FOUR of the following:**   16

a) Evaluate $\lim\limits_{x \to 0} \dfrac{e^{\tan 2x} - 1}{\sin 3x}$

b) Evaluate $\lim\limits_{x \to 0} \dfrac{\log(5 + x) - \log(5 - x)}{x}$

c) Find a real root of the equation $x^3 - 2x - 5 = 0$ using the bisection method in the interval (2, 3) carry out three iterations).

d) Using false position method, find the root of the equation $x^2 + x - 3 = 0$ in the interval (1, 2) by performing three iterations.

e) Solve $x^3 - x - 1 = 0$ by Newton Raphson method (up to three iterations.)

f) Find the root of $e^{-x} - x = 0$ by bisection method (up to three iterations.)

6.   **Solve any FOUR of the following:**   16

a) If $y = 2\cos(\log x) + 3\sin(\log x)$, prove that $x^2 \dfrac{d^2 y}{dx^2} + x\dfrac{dy}{dx} + y = 0$

b) Differentiate $\tan^{-1}\left(\dfrac{x}{1 + 12x^2}\right)$ w.r.t. x

c) Solve the following equations by Guass elimination method :
$x + y + z = 6, 2x - 3y + 3z = 5, 3x + 2y - z = 4$

d) Solve the following equations by Jacobi's method (take three iterations.)

$20x + y - 2z = 17, 2x - 3y + 20z = 25, 3x + 20y - z = 18$.

e) Solve the equations by Guass Seidal method (up to three iterations.)

$8x + 2y + 3z = 30, x - 9y + 2z = 1, 2x + 3y + 6z = 31$

f) With the following system of equations:

$3x + 2y = 4.5, 2x + 3y - z = 5, -y + 2z = 0.52$

g) Set up the Guass – Seidal iterations scheme for solution. Iterate two times, using initial approximations $x_0 = 0.4, y_0 = 1.6, z_0 = 0.4$

————

17216

11920

3 Hours / 100 Marks   Seat No.

Instructions – (1) All Questions are *Compulsory.*

(2) Answer each next main Question on a new page.

(3) Illustrate your answers with neat sketches wherever necessary.

(4) Figures to the right indicate full marks.

(5) Assume suitable data, if necessary.

(6) Use of Non-programmable Electronic Pocket Calculator is permissible.

(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

Marks

1.   Solve any TEN of the following: **20**

a) If $z = 1 - 3i$ Find $z^2 + 2z + 4$.

b) Find modulus and amplitude of $\dfrac{1}{2} + \dfrac{\sqrt{3}}{2}i$

c) State whether the function $f(x) = \dfrac{e^x + e^{-x}}{2}$ is even or odd.

d) If $f(x) = 3x^2 - 5x + 7$ show that $f(-1) = 3f(1)$

e) Evaluate : $\displaystyle \lim_{x \to 2} \dfrac{x^2 - 4}{x - 2}$

f) Evaluate : $\displaystyle \lim_{x \to 0} \dfrac{\sin 2x}{\sin 3x}$

g) Evaluate : $\displaystyle \lim_{x \to \infty} \left[1 + \dfrac{2}{x}\right]^x$

P.T.O.

Marks

h) Find $\dfrac{dy}{dx}$ if $y = \sin(\log x) + \cos(\log x)$

i) If $x^2 + y^2 = 25$ find $\dfrac{dy}{dx}$

j) If $x = at^2$ and $y = 2at$ find $\dfrac{dy}{dx}$

k) Show that root of equation $x^2 + x - 3 = 0$ lies between 2 and 3.

l) Find the first iteration by Gauss seidal method.
$10x + y + 2z = 13, \quad 3x + 10y + z = 14, \quad 2x + 3y + 10z = 15$

2.   **Solve any <u>FOUR</u> of the following :**   **16**

a) Express in polar form $z = -1 + \sqrt{3}\,i$

b) Simplify using De-Moiver's theorem.
$$\dfrac{(\cos 2\theta + i\sin 2\theta)(\cos\theta - i\sin\theta)^4}{(\cos 3\theta + i\sin 3\theta)(\cos 5\theta - i\sin 5\theta)^3}$$

c) Using Euler's formula prove that $\cosh^2\theta - \sinh^2\theta = 1$

d) Find cube root and unity by De-Moiver's theorem.

e) If $f(x) = \log(1 + \tan x)$ show that $f\left(\dfrac{\pi}{4} - x\right) = \log 2 - f(x)$

f) If $y = f(x) = \dfrac{2x - 3}{3x - 2}$ then prove that $f(y) = x$

3.   **Solve any <u>FOUR</u> of the following :**   **16**

a) If $f(t) = 50 \sin[100\,\pi t + 0.04]$ show that $f\left[\dfrac{2}{100} + t\right] = f(t)$

b) If $f(x) = \log x$ show that :
   (i) $f(mn) = f(m) + f(n)$
   (ii) $f\left(\dfrac{m}{n}\right) = f(m) - f(n)$

c) Evaluate : $\displaystyle\lim_{x \to 0} \dfrac{10^x - 5^x - 2^x + 1}{x^2}$

d) Evaluate : $\displaystyle\lim_{x \to 0} \frac{x \tan x}{1 - \cos x}$

e) Evaluate : $\displaystyle\lim_{x \to \infty} [\sqrt{x^2 + x + 1} - x]$

f) Evaluate : $\displaystyle\lim_{x \to 0} \frac{\log 10 + \log(x + 0.1)}{x}$

4. **Solve any FOUR of the following :** **16**

a) Using first principle of derivatives find derivatives of $f(x) = \sin x$

b) If u and v are differentiable function of x then prove that.
$$\frac{d}{dx} uv = u\frac{dv}{dx} + v\frac{du}{dx}$$

c) If $x^3 + y^3 = 4xy$ find $\frac{dy}{dx}$.

d) Differentiate w.r.t x : $\tan^{-1}\left[\frac{5x}{1 - 6x^2}\right]$

e) If $y = (\sin^{-1}x)^x$ find $\frac{dy}{dx}$.

f) If $x = a \cos^3 \theta,\ y = a \sin^3 \theta$ find $\frac{dy}{dx}$

5. **Solve any FOUR of the following :** **16**

a) Evaluate : $\displaystyle\lim_{x \to 0} \frac{\sqrt{1 + x} - \sqrt{1 - x}}{x}$

b) Evaluate : $\displaystyle\lim_{x \to \infty} \left(\frac{x + 1}{x - 1}\right)^x$

c) Using Bisection method find the approximate root of equation $x^3 - 6x + 3 = 0$ [Three iterations only]

d) Using Regula Falsi method find the root of equation $x^3 - 9x + 1 = 0$ [Three iterations only]

e) Solve the equation $x^3 - x - 1 = 0$ using Newton Raphson method taking initial root '1' [Three iterations only]

f) Find the root of equation $x \log_e x = 1.2$ by using Bisection method. [Three iterations only]

6. **Solve any FOUR of the following :** 16

a) Differentiate $\log(1+x^2)$ w.r.t. $\tan^{-1}x$

b) If $y = e^{\tan^{-1}x}$ show that $(1+x^2)\dfrac{d^2y}{dx^2} + (2x-1)\dfrac{dy}{dx} = 0$

c) Solve by Gauss - elimination method

$2x + y + z = 10; \quad 3x + 2y + 3z = 18; \quad x + 4y + 9z = 16$

d) Solve by Jacobi's method

$20x + y - 2z = 17; \quad 3x + 20y - z = -18; \quad 2x - 3y + 20z = 25$

(upto three iteration only)

e) Solve the following equations by Jacobi's method

$2x + 3y - 4z = 1; \quad 5x + 9y + 3z = 17; \quad 8x - 2y - z = 5$

(upto three iteration only)

f) With the following system of equation $5x - y = 9$, $5y - z = 6$, $x + 5z = -3$ Set up Gauss Seidal iteration scheme for the solution. Iterate two times using initial approximations, $x_0 = 1.8$, $y_0 = 1.2, z_0 = -0.96$.

————