UNIVERSITY OF THE PUNJAB

B.S. in Computer Science First Year : Annual–2021

Roll No. ....

Subject: Calculus I **Paper: 1** **Time: 2 Hrs. 30 Min.** **Marks: 80**

ATTEMPT THIS (SUBJECTIVE) ON THE SEPARATE ANSWER SHEET PROVIDED

NOTE: *Attempt any FOUR questions. All questions carry equal marks.*

Question No. 2:

a. Write any four properties of absolute values. **(4 marks)**

b. Solve an inequality below and express the solution set as an interval or union of the intervals. **(8 marks)**

$$x^{-2} - 4x^{-1} + 4 > 0$$

c. Say whether the functions are even, odd or neither. **(8 marks)**

$$f(x) = 3, f(x) = \frac{1}{x^2-1}, f(x) = \frac{1}{x-1} \text{ and } f(h) = |h^3|,$$

Question# 3

a. Write an equation for the line through $(-2,-1)$ and $(3,4)$. **(4 marks)**

b. Find the average rate of change of the functions over the given interval. **(8 marks)**

i. $f(x) = x^3 + 1,$ $[-1,1]$

ii. $f(t) = \cot t,$ $[\frac{\pi}{4}, \frac{3\pi}{4}]$

Find $\lim_{x \to 1} \cos\left(\frac{x^2-1}{x-1}\right)$

c. Find the discontinuities of $f(x) = \cos\frac{x}{x-\pi}$, if any. Determine $f(t) = \frac{\ln \tan^{-1} x}{x^2-9}$ is continuous. **(8 marks)**

Question No 4

a. Confirm that the stated formula is the local linear approximation of f at $x_0 = 1$, where $\Delta x = x - 1$. **(4 marks)**

$f(x) = x^4;$ $(1 + \Delta x)^4 \approx 1 + 4\Delta x$

b. Find the limit $\lim_{x \to 0^+} x^{\sin x}$. **(8 marks)**

c. i. Find an interval $[a, b]$ on which $f(x) = x^4 + x^3 - x^2 + x - 2$satisfies the hypotheses of Rolle's Theorem.

ii. Generate the graph of $f'(x)$, and use it to make rough estimates of all values of c in the interval obtained in part (i) that satisfy the conclusion of Rolle's Theorem.

iii. Use Newton's Method to improve on the rough estimates obtained in part (ii). **(8 marks)**

Question No 5

a. Write any four properties of indefinite integral. (4 marks)

b. Evaluate (8 marks)

i. $\int \left(\frac{1}{x} + sec^2 \pi x\right) dx$

ii. $\int sin^2 x \cos x \, dx$

c. Appropriate formulas from geometry to evaluate the integrals (8 marks)

i. $\int_{-1}^{3} (4 - 5x)\, dx.$

ii. $\int_{-3}^{0} \left(2 + \sqrt{9 - x^2}\right) dx.$

Question No 6

a. Define linear equation in terms of differential equation with its type and examples. (4 marks)

b. A tank with a 1000 gal capacity initially contains 500 gal of water that is polluted with 50 lb of particulate matter. At time $t = 0$, pure water is added at a rate of 20 gal/min and the mixed solution is drained off at a rate of 10 gal/min. How much particulate matter is in the tank when it reaches the point of overflowing? (8 marks)

c. Solve the differential equation $(x^2 + 1)\frac{dy}{dx} + xy = 0$ by the method of integrating factors. Solve the initial-value problem (8 marks)

$$x\frac{dy}{dx} + y = x, \; y(1) = 2.$$

Question No 7

a. Sketch the graphs of the ellipses $\frac{x^2}{9} + \frac{y^2}{16} = 1$. (4 marks)

b. Describe the graph of the equation (8 marks)

$$y^2 - 8x - 6y - 23 = 0$$

c. Sketch the hyperbola, and label the vertices, foci, and asymptotes. (8 marks)

$$16x^2 - y^2 - 32x - 6y = 57$$

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B.S. in Computer Science First Year : Annual–2021

Roll No. in Fig. ....

Subject: Calculus I

Roll No. in Words. ....

Paper: 1

Time: 30 Min. Marks: 20

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Attempt this Paper on this Question Sheet only.
Division of marks is given in front of each question.
This Paper will be collected back after expiry of time limit mentioned above.

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Signature of Supdt.:

Q.1. Fill in the blanks. (10x2=20)

1. The graph of $y = 1 + (x - 2)^2$ may be obtained by shifting the graph of $y = x^2$ and then shifting this new graph ____________ (up/down) by____________ unit(s).
2. Suppose that f and g are continuous functions such that $f(2) = 1$ and $\lim_{x \to 2}[f(x) + 4g(x)] = 13$. Then $g(2) =$ ____________.
3. Solve the first-order linear differential equation $\frac{dy}{dx} + p(x)y = q(x)$ by completing the following steps: Calculate the integrating factor μ. Multiply both sides of the equation by the integrating factor and express the result as $\frac{d}{dx}$[____________] = ____________. Integrate both sides of the equation obtained and solve for y
4. Suppose that the line $2x + 3y = 5$ is tangent to the graph of $y = f(x)$ at $x = 1$. The value of $f(1)$is ____________ and the value of $f'(1)$ is ____________.
5. The local linear approximation of f at x_0 uses the ____________ line to the graph of $y = f(x)$ at x = to approximate values of ____________ for values of x near ____________.
6. The graph of $y = x^2 + x$ is an integral curve for the function f(x) =____________. If G is a function whose graph is also an integral curve for f, and if $G(1) = 5$, then G(x) = ____________.
7. If $f''(a)$ exists and f has an inflection point at $x = a$, then $f''(a)$ ____________.
8. A function f has a relative maximum at x_0 if there is an open interval containing x_0 on which f(x) is ____________ $f(x_0)$ for every x in the interval.
9. Let $f(x) = \frac{3(x+1)(x-3)}{(x+2)(x-4)}$.Given that $f'(x) = -\frac{30(x-1)}{(x+2)^2(x-4)^2}$, $f''(x) = \frac{90(x^2-2x+4)}{(x+2)^3(x-4)^3}$. The relative maximum point on the graph is ____________.
10. Suppose that a hyperbola in standard position has semi focal axis a, semi conjugate axis b, and foci ($\pm$c, 0). Then c may be obtained from a and b by the equation c = ____________. The equations of the asymptotes of this hyperbola are y = ± ____________.

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Roll No. ....

B.S. in Computer Science First Year : Annual–2021

Subject: Calculus II **Paper: 2** **Time: 2 Hrs. 30 Min.** **Marks: 80**

ATTEMPT THIS (SUBJECTIVE) ON THE SEPARATE ANSWER SHEET PROVIDED

NOTE: *Attempt any FOUR questions. All questions carry equal marks.*

Question No. 2:

a. Find the center and radius of the sphere (4 marks)

$$x^2 + y^2 + z^2 - 2x - 4y + 8z + 17 = 0.$$

b. Let L_1 and L_2 be the lines (8 marks)

$$L_1 : x = 1 + 4t, y = 5 - 4t, z = -1 + 5t$$
$$L_2 : x = 2 + 8t, y = 4 - 3t, z = 5 + t$$

Are the lines parallel? Do the lines intersect?

c. An equation $2x + 3y + 4z = 1$ of a surface is given in rectangular coordinates. Find an equation of the surface in both cylindrical coordinates and spherical coordinates. (8 marks)

Question# 3

a. Find the slope of the line in 2-space that is represented by the vector equation $r = (1 - 2t)i - (2 - 3t)j$. (4 marks)

b. Find an arc length parametrization of the curve $r(t) = e^t \cos t\, i + e^t \sin t\, j$; $0 \le t \le \pi/2$ that has the same orientation as the given curve and for which the reference point corresponds to $t = 0$. (8 marks)

c. The graph of the vector equation $r = 2\cos t\, i + 3\sin t\, j\ (0 \le t \le 2\pi)$ is the ellipse. Find the curvature of the ellipse at the endpoints of the major and minor axes. (8 marks)

Question No 4

a. Suppose that $z = x^2 y, x = t^2, y = t^3$ Use the chain rule to find $\frac{dz}{dt}$, and check the result by expressing z as a function of t and differentiating directly. (4 marks)

b. Use Lagrange multipliers to find the maximum and minimum values of $f(x, y, z) = 3x + 6y + 2z$ subject to the constraint $2x^2 + 4y^2 + z^2 = 70$. Also, find the points at which these extreme values occur. (8 marks)

c. Find the absolute extrema of the function $f(x, y) = xe^y - x^2 - e^y$ on the indicated closed and bounded set R: the rectangular region with vertices (0, 0), (0, 1), (2, 1), and (2, 0). (8 marks)

Question No 5

a. Evaluate the double integral $\iint 4xy^3\, dA$ over the rectangular region
$$R = \{(x, y) : -1 \leq x \leq 1, -2 \leq y \leq 2\}.$$
(4 marks)

b. The sphere $x^2 + y^2 + z^2 = a^2$ can be expressed in spherical coordinates as $\rho = a$, and the spherical-to-rectangular conversion formulas can then be used to express the sphere as the vector-valued function
$$r(\varphi, \theta) = a \sin\varphi \cos\theta i + a \sin\varphi \sin\theta j + a \cos\varphi k$$
where $0 \leq \varphi \leq \pi$ and $0 \leq \theta \leq 2\pi$. Use this function to show that the radius vector is normal to the tangent plane at each point on the sphere. (8 marks)

c. Evaluate the iterated integral. (8 marks)
$$\int_1^2 \int_z^2 \int_0^{\sqrt{3}y} \frac{y}{x^2 + y^2}\, dx\, dy\, dz$$

Question No 6

a. Find the divergence and the curl of the vector field (4 marks)
$$F(x, y, z) = x^2 y i + 2y^3 z j + 3z k.$$

b. Evaluate the line integral $\oint_C y^2 dx + x^2 dy$ where C is the square with vertices (0, 0), (1, 0), (1, 1), and (0, 1) oriented counterclockwise, by using Green's Theorem and check the answer by evaluating it directly. (8 marks)

c. Verify the Stokes' Theorem by evaluating the line integral and the surface integral. Assume that the surface has an upward orientation. (8 marks)
$$F(x, y, z) = (z - y)i + (z + x)j - (x + y)k;$$
σ is the portion of the paraboloid $z = 9 - x^2 - y^2$ above the xy-plane.

Question No 7

a. Use the Divergence Theorem to find the outward flux of the vector field $F(x, y, z) = 2xi + 3yj + z^2 k$ across the unit cube (4 marks)

b. Find the flux of the vector field F across σ. (8 marks)
$F(x, y, z) = x^2 i + (x + e^y) j - k$; σ is the vertical rectangle $0 \leq x \leq 2, 0 \leq z \leq 4$ in the plane $y = -1$, oriented in the negative y-direction.

c. Evaluate the surface integral $\iint_\sigma xz\, dS$ where σ is the part of the plane $x + y + z = 1$ that lies in the first octant. (8 marks)

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Roll No. in Fig. ....

B.S. in Computer Science First Year : Annual–2021

Roll No. in Words. ....

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Subject: Calculus II   Paper: 2   Time: 30 Min. Marks: 20

Attempt this Paper on this Question Sheet only.
Division of marks is given in front of each question.
This Paper will be collected back after expiry of time limit mentioned above.

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Signature of Supdt.:

Q.1. Fill in the blanks. (10x2=20)

1. Let S be the graph of $x^2 + z^2 + 6z = 16$ in 3-space.The intersection of S with the xz-plane is a circle with center ____________ and radius ____________.
2. $\langle 1, 2, 0\rangle \times \langle 3, 0, 4\rangle =$ ____________.
3. A normal vector for the plane $4x - 2y + 7z - 11 = 0$ is ____________.
4. $\lim_{t \to \frac{\pi}{4}} \langle \cos t, \sin\rangle =$ ____________.
5. Let $f(x, y) = \frac{x-y}{x+y+1}$. $f(y + 1, y) =$ ____________.
6. Suppose that $f(1, 0, -1) = 2$, and $f(x, y, z)$ is differentiable at $(1, 0, -1)$ with $\nabla f(1, 0, -1) = (2, 1, 1)$. An equation for the tangent plane to the level surface $f(x, y, z) = 2$ at the point $(1, 0, -1)$ is ____________, and parametric equations for the normal line to the level surface through the point $(1, 0, -1)$ are $x=$ ____________, $y=$ ____________, $z=$ ____________.
7. The volume of the solid enclosed by the surface $z = \frac{x}{y}$ and the rectangle $0 \le x \le 4, 1 \le y \le e^2$ in the xy-plane is ____________.
8. The iterated integral $\int_1^5 \int_2^4 \int_3^6 f(x, y, z)\, dx\, dz\, dy$ integrates f over the rectangular box defined by ____________ $\le y \le$ ____________.
9. If C is the unit circle centered at the origin and oriented counterclockwise, then $\int_C (y^3 - y - x)\, dx + (x^3 + x + y)\, dy =$ ____________.
10. Suppose that σ is the parametric $surface$ $r(u, v) = ui + vj + (u + v)k$, $(0 \le u^2 + v^2 \le 1)$ and that n is a positive multiple of $\frac{\partial r}{\partial u} \times \frac{\partial r}{\partial v}$. Then the flux of $F(x, y, z) = xi + yj + zk$ across σ is $\varphi =$ ____________.

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B.S. in Computer Science First Year : Annual–2021

Subject: Programming Fundamentals

Paper: 3-N

Time: 30 Min. Marks: 15

Roll No. in Fig. ....

Roll No. in Words. ....

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Signature of Supdt.:

Attempt this Paper on this Question Sheet only.
Division of marks is given in front of each question.
This Paper will be collected back after expiry of time limit mentioned above.

Q.1. Encircle the right answer cutting and overwriting is not allowed. (10x1½=15)

I. Is const better than #define?

A. Yes B. No

II. Can we create array of reference?

A. Yes B. No

III. When can we have two classes with same name?

A. We can't have B. In different work space

C. Can have but in different file D. We can have in any Scenario

IV. Can a class contain another class in it?

A. Yes B. No

V. What is the size of void in C++?

A. 2 bytes B. 4 bytes C. Undefined D. 0

VI. Can a function call itself?

A. Yes B. No

VII. Can a structure contain pointer to itself?

A. Yes B. No

VIII. Which operator has highest precedence?

A. ++ B. * C. = D. ()

IX. Can we have constructor as Virtual?

A. Yes B. No

X. Can we have pure Virtual Destructor?

A. Yes B. No

UNIVERSITY OF THE PUNJAB

B.S. in Computer Science First Year : Annual–2021

Roll No. ....

Subject: Programming Fundamentals **Paper: 3-N** **Time: 2 Hrs. 30 Min. Marks: 60**

ATTEMPT THIS (SUBJECTIVE) ON THE SEPARATE ANSWER SHEET PROVIDED

NOTE: ***Attempt any FOUR questions. All questions carry equal marks.***

Q.2. Write the output of following code segments: **(15)**

(a)

```
class Calc
{
  char Grade;
  int Bonus;
 public:
  Calc()
  {     Grade = 'E';
        Bonus = 0;
  }
  void Down(int G)
  {
    Grade -= G;
  }
  void Up(int G)
  {
    Grade += G;
    Bonus++;
  }
  void Show()
  {
    cout << Grade << "#" << Bonus << endl;
  }};
int main()
{
   Calc C;
   C.Down(2);
   C.Show();
   C.Up(7);
   C.Show();
   C.Down(2);
   C.Show();
}
```

(b)

```
int main()
{
   char *String = "Welcome";
   int *Point, Value[] = {10,15,70,19};
   Point = Value;
   cout << *Point << String << endl;
   String++;
   Point++;
   cout << *Point << String << endl;
}
```

(c)

```
#include<iostream>
using namespace std;
class Test
{        private :
                 int marks = 85;
         public :
                 Test(int marks)
                 {
                          cout<< this->marks;
                          cout<<endl;
                 }
};
int main()
{
        Test t(95);
        return 0;
}
```

(d)

```
#include <iostream>
using namespace std;
int main()
{   int i, x[5], y, z[5];
   for (i = 0; i < 5; i++) {
      x[i] = i;
      z[i] = i + 3;
      y = z[i];
      x[i] = y++; }
   for (i = 0; i < 5; i++)
      cout << x[i] << " ";
   return 0;
}
```

(e)

```
#include<iostream>
#include<cstring>
using namespace std;
int main()
{
        char *s="GOODLUCK";
        for(int i=strlen(s)-1;i>=0;i--)
        {
                 for(int j=0;j<=i;j++)
                 cout<<s[j];
                 cout<<endl;
        }
        return 0; }
```

Question # 3:

Write a program that displays the following output using any loop.

```
1   2   3   4   5   4   3   2   1
1   2   3   4       4   3   2   1
1   2   3               3   2   1
1   2                       2   1
1                               1
```

Question # 4:

Define a class Time that includes three pieces of information as data members -- hours (type int), minutes (type int), seconds (type int). Write a program that takes two time as an input , add the two times and then print the new time.

Sample data:

Enter 1st time:
Hours? 15
Miuntes? 35
Seconds? 22
Enter 2nd Time:
Hours? 20
Minutes?20
Seconds?15
~~New Time after Add:~~

Question # 5:

Define a function named monthly-profit which will calculate the monthly profit on the given investment amount. Function will take two float arguments, percent profit rate and investment amount and return the monthly profit (float). Write function prototype, function definition and a main program to demonstrate the functionality.

Note: User can enter any values therefore write generalized function for user variables (Not initialized the variable value).

Question #6:

Define a class Employee to store the records of employees. We want to store only Name, age and address of employee. Write main program to input record of one person and display 'Young' if its age is less than 20 or 'Old' if the age is greater than 50 and 'Middle' if the age of person is between 21 and 49.

Question #7:

Write a program that sort the given data in descending order using bubble sort technique?

5   15   20   4   33   1   8   19

UNIVERSITY OF THE PUNJAB

B.S. in Computer Science First Year : Annual–2021

Roll No. ....

Subject: Electricity and Magnetism & Basic Electronics Paper: 5-N Time: 2 Hrs. 30 Min. Marks:80

ATTEMPT THIS (SUBJECTIVE) ON THE SEPARATE ANSWER SHEET PROVIDED

NOTE: ***Attempt TWO questions from each Section. All questions carry equal marks.***

Section – I
ELECTRICITY AND MAGNETISM

Question no. 2: **(10+5+5=20)**

a) What is an electric dipole? Find the electric field of an electric dipole at a field point P.
b) Explain the phenomena of conductor in an electric field under static condition with the help of diagrams.
c) A cube with 1.4 m edges is oriented in a region of uniform electric field as shown in figure. Find the electric flux through the front face of the cube if the electric field is given by $\mathbf{E} = (-3N/C)\,\hat{i} + (6N/C)\,\hat{j}$. Also calculate the total flux through the cube.

Question no.3: **(10+5+5=20)**

a) Find the magnetic field of current carrying straight wire and a current carrying solenoid with the help of Ampere's law.
b) Differentiate between magnetism and electromagnetism.
c) An electron moving at 5.6×10^7 m/s travels through a uniform magnetic field of 1.4 T at right angles to the field. How strong is the force that acts on the electron?

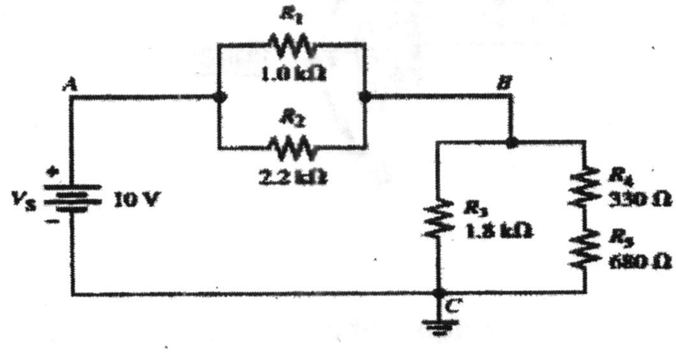
Question no.4: **(10+5+5=20)**

a) State and explain Gauss's law. Find the electric force due to an infinite sheet of charges.
b) Write the properties of electric field lines.
c) Consider a point charge q_1= +2.2μC at the origin and a second point charge q_2= +1.2μC at a distance L along x axis, where L=15cm. Find the point P along the x axis where the electric field is equal to zero.

Section – II
BASIC ELECTRONICS

Question no. 5: **(12+8=20)**

a) Find the current and voltage drop across each resistor shown in figure.

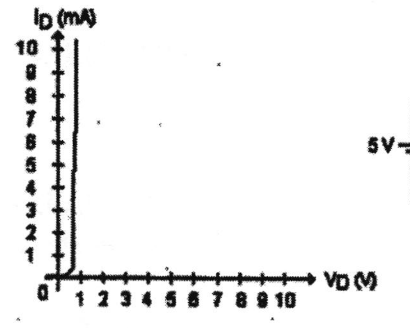


b) Discuss various voltage sources.

P.T.O.

Question no. 6: **(10+10=20)**

a) Describe load-line analysis. Figure shows the characteristics curve of a Silicon diode inserted in a circuit having resistor with resistance R. Find the Q-point on the graph. If resistance value is doubled, what is the effect on I_{DQ} and V_{DQ}.

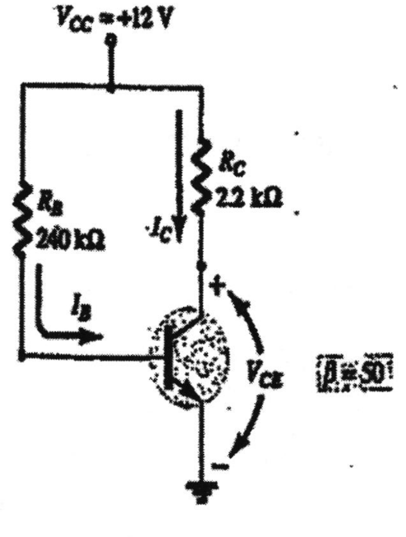


b) What is a diode? Describe the forward biasing and reversed biasing of a semiconductor diode with the help of schematic diagrams and briefly explain.

Question no. 7: **(10+10=20)**

a) Describe the operations of *NPN* and *PNP* transistor. Also draw the diagrams that show its working in active region (input side forward biased and output side reverse bias) for Common base configuration. Also draw characteristics curves for input and output sides.

b) For the fixed bias circuit, using a silicon transistor, find the value of I_B, I_C, I_E, V_{CE} and V_{CB} when V_{CC}= 12V, R_B=240kΩ, R_C=2.2kΩ.



UNIVERSITY OF THE PUNJAB

Roll No. in Fig. ....

B.S. in Computer Science First Year : Annual–2021

Roll No. in Words. ....

Subject: Electricity and Magnetism & Basic Electronics
Paper: 5-N

Time: 30 Min. Marks: 20

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Signature of Supdt.:

Attempt this Paper on this Question Sheet only.
Division of marks is given in front of each question.
This Paper will be collected back after expiry of time limit mentioned above.

Q.1. Encircle the right answer cutting and overwriting is not allowed. (10x2=20)

1) Electric charges A and B are attracted to each other, electric charges B and C repel each other, if electric charges A and C are held close together they will _______ each other.
   a) Attract c) Repel
   b) No effect d) More information is needed to answer

2) If a point charge Q is located at the center of a cube then find flux through one surface.
   a) Q / ε_o b) $Q / 2\, \varepsilon_o$ c) $Q / 6\, \varepsilon_o$ d) $Q / 8\, \varepsilon_o$

3) A bar magnet is divided in two pieces. Which of the following statements is true?
   a) The bar magnet is demagnetized.
   b) The magnetic field of each separated piece becomes stronger.
   c) The magnetic poles are separated.
   d) Two new bar magnets are created.

4) The direction of electric field of a dipole is
   a) From positive to negative charge c) From negative to positive charge
   b) back to front d) none of these

5) If a current carrying conductor is placed in uniform magnetic field parallel to direction of field then force experienced by conductor will be
   a) ILBCos b) ILB c) Zero d) none of these

6) When a PN junction is reverse-biased
   a) Holes and electrons tend to concentrate towards the junction
   b) The barrier tends to break down
   c) Holes and electrons tend to move away from the junction
   d) None of the above

7) A silicon diode in a half-wave rectifier has a barrier potential of 0.7 V. This has the effect of
   a) Reducing the dc input voltage by 0.7 V c) Increasing the dc output voltage by 0.7V
   b) Reducing the dc output voltage by 0.7V d) no effect

8) Process of linearly increasing amplitude of an electrical signal is called
   a) switching b) amplification c) clipping d) none

9) Which of the following is the correct relationship between base and emitter current of a BJT?
   a) $I_B = \beta\, I_E$ b) $I_B = I_E$ c) $I_B = (\beta + 1)\, I_E$ d) $I_E = (\beta + 1)\, I_B$

10) Equivalent resistance of a series circuit is greater than the ________ resistance of that circuit.
   a) least b) greatest c) same d) none