University of Dhaka
Department of Computer Science & Engineering
1st Year 1st Semester B. Sc. Final Examination, 2017
CSE - 1101: Fundamentals of Computer and Computing

Total Marks: 60 **Time: 2.5 Hours**

(Answer any 4 of the following questions)

1. a) All data in the Universe can be classified into three basic types: numeric, alpha-numeric and logical. Describe the properties of each basic data type with examples. 6
   b) How do we measure the computing power of a computer? 5
   c) What is the difference between a procedure and an algorithm? 4

2. a) Explain the process of storing data in a DVD? Why does a DVD hold more data than a CD? 5
   b) Differentiate between an application and a utility software. 3
   c) What are the advantages of Solid State Drives over regular Hard Drives? 3
   d) Explain the working principles of USB. Mention different types of USBs. 4

3. a) In any computer programming language, we use five basic types of statements: assignment, function calls, returning from functions, branching, and looping. Explain each statement type with its purpose. 5
   b) What would be the value of i after completing the following pseudo-code? 4

```
x := 1;
i := 1;
while (x <= 1000)
  begin
    x := 2*x ;
    i := i + 1;
  end;
```

   c) Convert the pseudo-code given in question 3(b) into a flow-chart. 6

4. a) Find the results in the given number systems without converting them to other number systems: 8
   i. $(27)_{16} + (19)_{16} = (?)_{16}$
   ii. $(01110011)_2 + (00011111)_2 = (?)_2$
   iii. $(01110011)_2$ AND $(00011011)_2 = (?)_2$ (Here, AND means bit-wise AND operation)
   iv. $(3D8)_{16} + (A46)_{16} = (?)_{16}$
   b) Suppose a, b, c are integer variables with values 5, 6, and 7, respectively. What is the value of the expression: !((b+c)>(a+10)) 3
   c) Suppose, you want to use a trinary number system with 3 symbols: 0, A and B. Convert $(420)_{10}$ into this trinary number system. 4

5. a) Propose a policy to maintain internet security for a home network. 5
   b) Distinguish among virus, Trojan horse and worms. 4
   c) Do you think open source software are more secure? Why? Why not? 3
   d) Write down the features of your favorite social networking site. 3

6. a) What are the basic properties of an 'Array'? 3
   b) Suppose, the following class definition models a point in a 3D space: 7

```
class Point {
   private float x, y, z;
   public void setCoordinates(float xPos, float yPos, float
zPos) {….};
   public float getDistance(Point otherPoint) { …. };
}
```

   where, the `setCoordinates` and `getDistance` functions can set location of the point in a 3D space and measure the distance from another point, respectively.
   For the given model for a point,
   i. Define an array of 30 points in the main function.
   ii. Write down the C/C++ like statement that would print the distance of the 14-th point from the 23-rd point in the array using the `getDistance` function.
   c) Draw how memory is allocated for the following array definitions: 5

```
i. char myNumbers[11];
ii. unsigned char myNumbers[11];
```

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Department of Computer Science and Engineering

1st Year 1st Semester B. Sc. Final Examination 2017

CSE 1102: Discrete Mathematics

Duration: 2.5 hours **Credits: 3** **Full Marks: 60**

(Answer any four of the following six questions)

1. a) Prove that all functions are relations but all relations are not functions. 2.5
   b) Consider a set A = {1, 2, 3} and the function f on A defined by f= {(1,2), (2,2), (3,3)}. Is the function invertible? 1
   c) Distinguish between one-one and onto functions. 3
   d) Find cardinal number of the following set: A = {3, 5, 9, 17, 33, ···} 1.5
   e) $xy = 16$ is a relation on the positive integers N. Is the relation i) Symmetric? ii) Antisymmetric? iii) Reflexive? 3
   f) Consider a set S = {a, b, c} and the relation R on S defined by R = {(a,b), (a,c), (b,a), (c,c)}. Find transitive (R). 2.5
   g) Let A = {1, 3, 5, 7} and B = {2, 4, 6, 8}. Find symmetric difference of A and B. 1.5

2. a) Mention two properties of a partition of a set. Show example. 3
   b) Express the statement "If a person is a male and is a parent, then this person is someone's father" as a logical expression. 1.5
   c) Express the following statements using logical connectors and quantifiers. 3
      i) Nothing is perfect.
      ii) There is a horse that can run fast.
   d) Prove the following argument using rules of inference. 3
      "Nahid, a student in this class enjoys bird watching. Every person who enjoys bird watching cares about environmental pollution. Therefore, there is somebody in this class who cares about environmental pollution."
   e) State contrapositive of the implication: If 1+2 = 4 then dogs can swim. 1
   f) Determine whether the following argument is correct or incorrect and explain why. 1.5
      "All lobstermen set at least a dozen traps. Rahim set a dozen traps. So, Rahim is a Lobsterman."
   g) Are the following propositions logically equivalent? 2
      $\neg p \rightarrow (q \rightarrow r)$ and $q \rightarrow (p \wedge r)$

3. a) Prove by induction: a binary tree with height H has at most 2^H-1 nodes. 6
   b) Given $F_0 = a, F_1 = b$ and $F_N = F_{N-1} + F_{N-2}$, derive a formula for summation of all the terms from F_0 to F_N. 6
   c) Using strong induction, prove that if n is an integer greater than 1, then n can be written as product of primes. 3

4. a) Consider s = Q × Q, the set of ordered pairs of rational numbers with the operation * defined by $(a, b) * (c, d) = (ac, ad + b)$ 4
      i) Is (S,*) a semigroup? Is it commutative?
      ii) Find the identity element for *.
      iii) Which elements have inverses and what are they?
   b) Define homomorphism of semigroups. Let $S = N \times N$ and * be the operation on S defined by $(a, b) * (c, d) = (a - c, b - d)$. Define $f: (S,*) \rightarrow (Z,+)$ by $f(a, b) = a + b$. Is f a homomorphism? 3
   c) Consider the group G={1, 3, 7, 9} under multiplication modulo 10. Is G cyclic? Let H be the subgroup generated by 9. Is it a normal subgroup? 3
   d) Define Ring. 3
   e) Let σ be the following element of the symmetric group S_7: 2
      $\sigma = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 3 & 5 & 1 & 2 & 6 & 4 \end{pmatrix}$ and $\alpha = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 5 & 4 & 3 & 6 & 1 & 2 \end{pmatrix}$. Find σ^{-1} and $\sigma\alpha$.

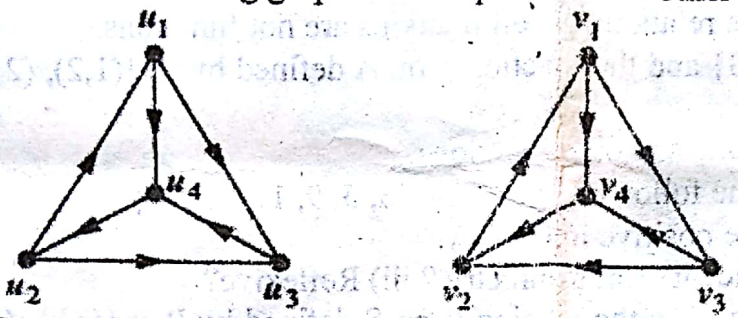
5. a) Given $A + B + C + D + E = N$, how many different positive integer solutions does this equation have, given a particular N? For example, if $N = 5$ there is only one solution (1, 1, 1, 1, 1) but if $N = 6$, then there are 5 different solutions. 6
   b) You are given a book shelf with three different selves. In how many different ways can you put 10 different books in the book shelf? The order of the book in a particular 4

shelf doesn't matter.

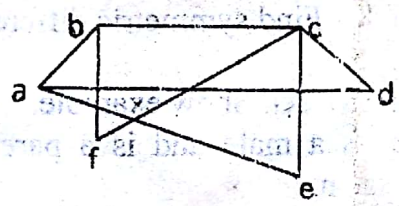
c) There are more than 72 students in your class. So it can be proved that there are at least 6 students who have their birthday in the same month. How can you do that? If someone says that there are at least 6 students who have their birthday at January, is it always true for 72 students in a class? Why or why not? **5**

6. a) What is the main difference between a complete and a connected graph. **2**

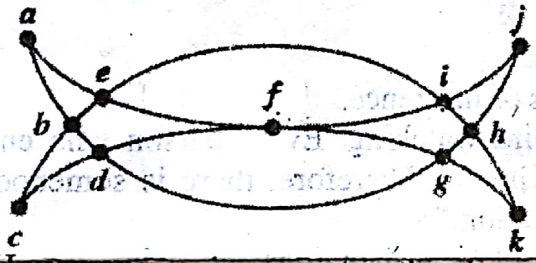
b) Are the following graphs isomorphic to each other? Prove. **5**



c) Find out the chromatic number of the following graph. **2.5**

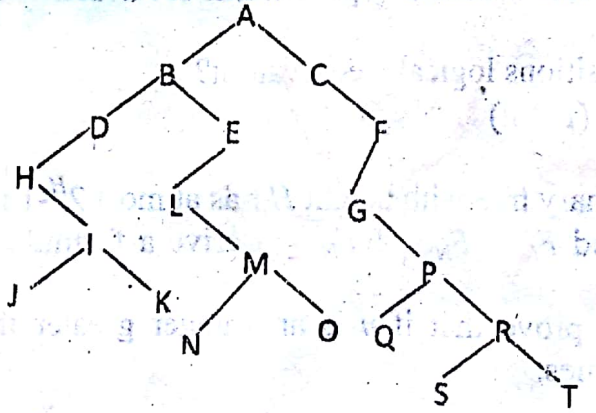


d) Is it possible to exist an Euler circuit in the following graph? If possible derive it. **2.5**



e) How many regions exist in the above graph? Prove Euler's formula from this graph. **2**

f) Traverse the following tree in inorder way. **1**



University of Dhaka
Department of Computer Science and Engineering
1st Year 1st Semester B. Sc. Final Examination 2017
EEE-1103: Electrical Circuits

Duration: 2.5 hours **Credits: 3** **Full Marks: 60**

(Answer any four of the following six questions)

1. a) What are the usages of Ohm meter? 2
   b) What is the relative increase or decrease in conductivity of a conductor if the area is reduced by 30% and the length is increased by 40%? The resistivity is fixed. 3
   c) Define efficiency with the help of energy flow through a system. An electric motor used in an elevator system has an efficiency of 90%. If the input voltage is 220 V, what is the input current when the motor is delivering 15 hp? 6
   d) i) Find the internal resistance of a battery that has a no load output of 60 V and that supplies a full-load current of 2 A to a load of 28 Ω. 4
   ii) Find the voltage regulation of the supply and sketch the equivalent circuit for the supply.

2. a) State Kirchhoff's Voltage. Prove that the total resistance of a series configuration is the sum of the resistance levels using Kirchhoff's voltage law. 3
   b) For the network in **Fig. 2.1**, determine the voltages: 4
   i) V_a, V_b, V_c, V_d
   ii) V_{ab}, V_{cb}, V_{ad}, V_{ca}
   c) Find the unknown quantities for the circuits in **Fig. 2.2** using the information provided. 3

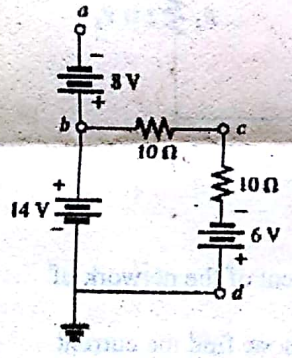


Fig. 2.1

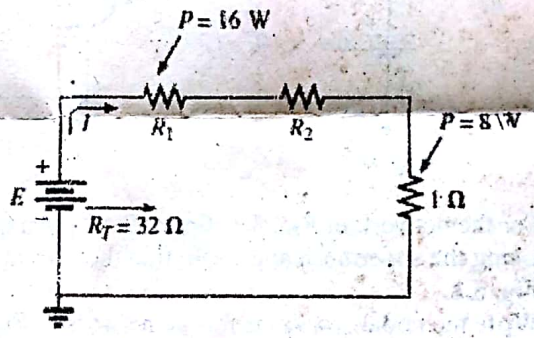


Fig. 2.2

   d) Can two batteries of different voltages be placed in parallel? Explain the consequences. 2
   e) For the network of **Fig. 2.3**, determine the unknown currents. 3

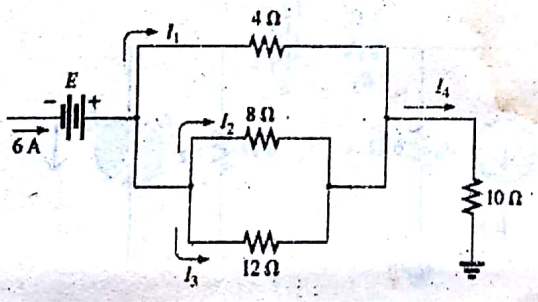


Fig. 2.3

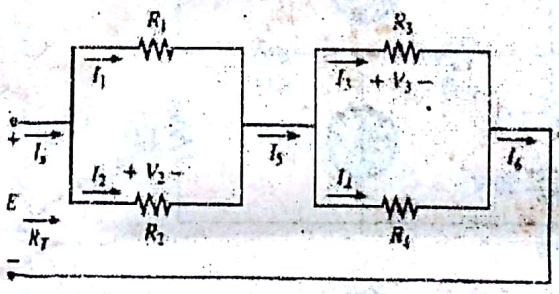


Fig. 3.1

3. For the network in **Fig. 3.1**
   a) Does $I_s = I_5 = I_6$? Explain. 2
   b) If $I_s = 10$ A and $I_1 = 4$ A, find I_2. 2
   c) Does $I_1 + I_2 = I_3 + I_4$? Explain. 2
   d) If $V_2 = 8$ V and $E = 14$ V, find V_3. 2
   e) If $R_1 = 4\ \Omega$, $R_2 = 2\ \Omega$, $R_3 = 4\ \Omega$, and $R_4 = 6\ \Omega$, what is R_T? 3
   f) If all the resistors of the configuration are 20 Ω, what is the source current if the applied voltage is 20 V? 2
   g) Using the values of part (f), find the power delivered by the battery and the power absorbed by the total resistance R_T. 2

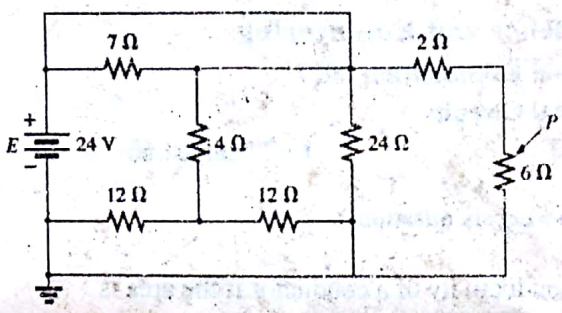


Fig. 4.1

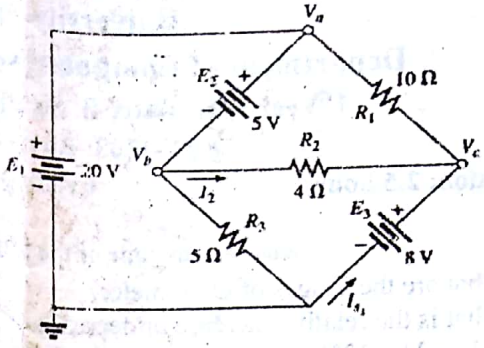


Fig. 4.2

4. a) "In any configuration, if two elements are in series, the current must be the same. However, if the current is the same for two adjoining elements, the elements may or may not be in series."-Explain with example. 3

b) Determine the power delivered to the 6 Ω load in **Fig. 4.1.** 4

c) For the network in **Fig. 4.2**: 4
i) Determine voltages V_a, V_b, and V_c. ii) Find current I_2 and the source current I_{S3}

d) For the network in **Fig. 4.3**: 4
i) Determine the currents I_s, I_1, I_3, and I_4. ii) Calculate V_a and V_{bc}.

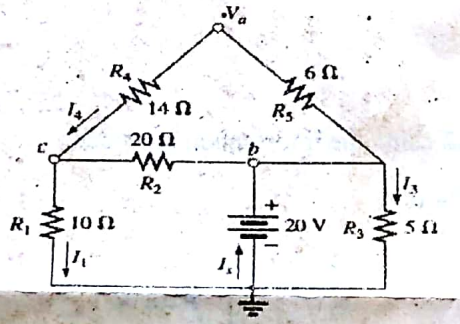


Fig. 4.3

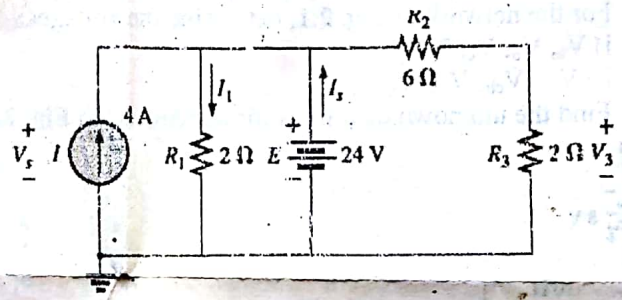


Fig. 5.1

5. a) For the network in **Fig. 5.1**, find the unknown quantities. 4

b) Using the supermesh approach, find the current through each element of the network of **Fig. 5.2.** 4

c) Write the nodal equations for the network in **Fig. 5.3** and solving those find the current through the 4 Ω resistor. 4

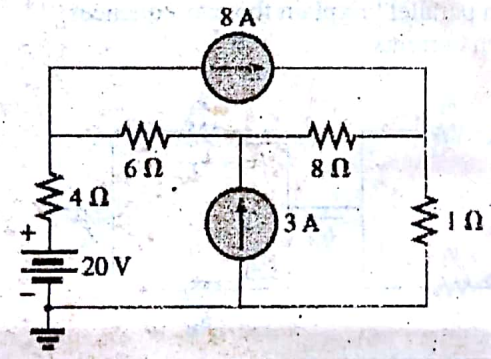


Fig. 5.2

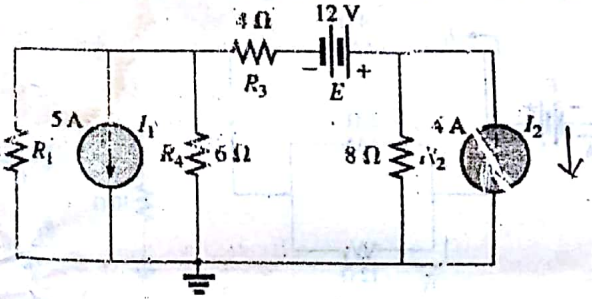


Fig. 5.3

d) Using a Δ-Y and Y-Δ conversion, compare the current I in the network in **Fig. 5.4.** 3

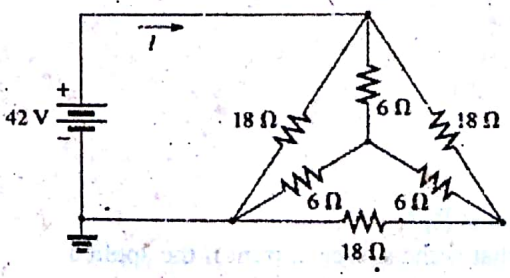


Fig. 5.4

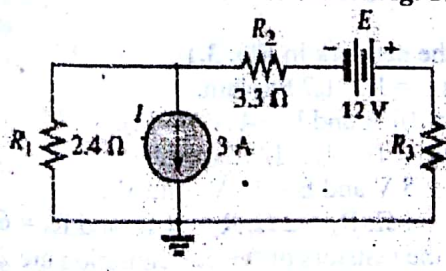


Fig. 6.1

6. a) For **Fig. 6.1** 6

i. Using the superposition theorem, determine the voltage across the 4.7 Ω resistor of.

ii. Find the power delivered to the 4.7 Ω resistor due solely to the current source.

iii. Find the power delivered to the 4.7 Ω resistor due solely to the voltage source.

b) In **Fig. 6.2**

i. Find the Thévenin equivalent circuit for the network external to the resistor R for the network. 5

ii. Find the power delivered to R when R is 2 Ω and 100 Ω.

c) For Fig. **6.3;** 4

i. Find the time required for v_C to reach 48 V following the closing of the switch.

ii. Calculate the current i_C at the instant $v_C = 48$ V.

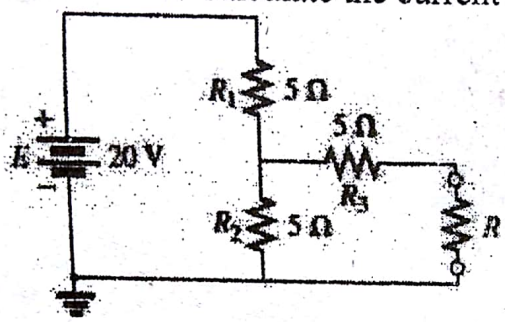


Fig. 6.2

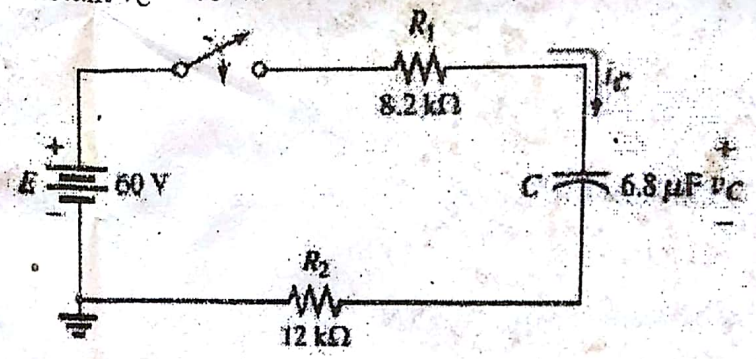


Fig. 6.3

University of Dhaka
Department of Computer Science and Engineering
1st Year 1st Semester B. Sc. Final Examination 2017
PHY-1104: Physics

Duration: 2.5 hours **Credits: 3** **Full Marks: 60**

(Answer any four of the following six questions)

1. a) State 1st Law of Thermodynamics. What do you understand by "Internal Energy"? 4
   b) With appropriate diagram, describe the phase change process of water at 1atm pressure. 6
   c) A piston-cylinder device contains $0.05m^3$ of a gas initially at 200kPa. At this state, a linear spring that has a spring constant of 150kN/m is touching the piston but exerting no force on it. Now heat is transferred to the gas, causing the piston to rise and to compress the spring until the volume inside the cylinder doubles. If the cross-sectional area of the piston is $0.25m^2$, determine the 5
      (i) final pressure inside the cylinder,
      (ii) total work done by the gas, and
      (iii) fraction of this work done against the spring to compress it.

2. a) What is Carnot's cycle? Explain different steps of the Carnot's cycle. 5
   b) A Carnot engine is operated between two reservoirs at temperature of 450k and 350k. If the engine receives 1kcal of heat from the source in each cycle, calculate (i) amount of heat rejected to the sink in each cycle, (ii) efficiency of the engine and (iii) work done by the engine in each cycle. 6
   c) Imagine you had the unfortunate occasion of being slapped by an angry person, which caused the temperature of the affected area of your face to rise by 1.8°C (ouch!). Assuming the slapping hand has a mass of 1kg and about 0.12kg of the tissue on the face and the hand is affected by the incident, estimate the velocity of the hand just before impact. Take the specific heat of the tissue to be 3.9kJ/kg°C. 4

3. a) Define primitive and non-primitive unit cell. How can you construct a Wigner-Seitz cell? 4
   b) What is packing fraction? Find out packing fraction for hexagonal close-packed (hcp) structure. 6
   c) Derive Bragg's law. Write down about its application. 5

4. a) Prove that a spring-mass system is a simple harmonic motion system. 5
   b) What do you understand by energy of a simple harmonic oscillator? Explain. 6
   c) A point moves with simple harmonic motion whose period is 4s. If it starts from rest at a distance 4.0cm from the center of its path, find the time that elapses before it has described 2cm and the velocity it has then acquired. How long will the point take to reach the center of its path? 4

5. a) Solve the differential equation of a dumped harmonic oscillator. 7
   b) In the same displacement vs. time graph how the three types of damping. 4
   c) For a mass-spring system with m = 250g, k = 85N/m, and b = 70g/s, what is the ratio of the oscillation amplitude at the end of 25 cycles to the initial oscillation amplitude? 4

6. a) What is diffraction of light? 2
   b) Derive an expression of intensity distribution in case of double slit and hence find the positions of maxima and minima. 8
   c) Consider a diffraction grating with 15,000 lines per inch. 5
      (i) Show that if we use a white light source, the second- and third-order spectra overlap.
      (ii) What will be the angular separation of the D1 and D2 lines of sodium in the second-order spectra?

University of Dhaka

Department of Computer Science and Engineering

1st Year 1st Semester B. Sc. Final Examination 2017

MATH-1105: Differential and Integral Calculus

Duration: 2.5 hours **Credits: 3** **Full Marks: 60**

(Answer any four of the following six questions)

1. a) Sketch the graph of the following functions. Also find their domain and range. 10

$(i)\ f(x) = x^2 - 8x + 19,\quad (ii)\ f(x) = \ln(x+1),\ (iii)\ y = \frac{x^2-1}{x^2+1}$

$(iv)\ f(x) = \frac{|x-1|}{x-1}$

b) Determine whether $f(x) = \sqrt{x},\ x \geq 0$ is one-one function. If it is one-one then find $f^{-1}(x)$. Also draw the graph of $f(x)$ and $f^{-1}(x)$ in the same axes. Finally, comment on their symmetry. 5

2. a) Consider the following function:

$$f(x) = \begin{cases} 3 - x^2 & 0 \leq x < 1 \\ 2 & x = 1 \\ |3 - x| & 1 < x \leq 4 \\ \frac{1}{x-4} & 4 < x \leq 5 \\ 1 & x > 5 \end{cases}$$

i) Evaluate the limits: $\lim_{x\to 1} f(x)$ and $\lim_{x\to 4} f(x)$ 3

ii) Is $f(x)$ continuous at $x = 1$ and $x = 4$? 3

iii) Is f differentiable at $x = 1$ and on $(1, 4)$? Answer with appropriate reasoning. 4

b) Apply L' Hospitals rule to evaluate 5

$(i)\ \lim_{x\to\infty} \frac{x - \tan x}{x^3}$ $(ii)\ \lim_{x\to 0} \frac{e^x - e^{-x} - 2x}{x^2 \sin x}$

3. a) Find the maximum and minimum values of $1 + 2\sin x + 3\cos^2 x,\ 0 \leq x \leq \pi/2$. 5

b) Let $f(x) = x + \frac{4}{x}$. Find the intervals where $f(x)$ is increasing, decreasing also find the local maxima and local minima of $f(x)$. 5

c) State Taylor's series and Mean value theorem. Verify Mean value theorem for the function $f(x) = x^3 - x^2 - 4x + 4$ in the interval (-2,2). 5

4. a) Evaluate the following integrals (Any 4): 12

$$(i) \int \frac{7 - 6\sin^2\theta}{\sin^2\theta} d\theta \quad (ii) \int x\cos^2 x\, dx \quad (iii) \int \frac{e^x}{e^{2x} + 2e^x + 5} dx$$

$$(iv) \int_0^\infty x^2 e^{-2x^3}\, dx \quad (v) \int_0^1 (\ln x)^4\, dx \quad (vi) \int_0^{\pi/2} \sin^5 x \cos^6 x\, dx$$

b) Suppose the function $f(x)$ is continuous on $[a, b]$. How would you calculate net signed area and total area of $f(x)$ enclosed between $x = a$ and $x = b$? 3

5. a) Find the area of the region that is enclosed between the curve $x = y^2/4$ and $y = 2x - 4$. 5

b) Find the volume of the solid generated when the region under the curve $y = \sqrt{x}$ over the interval [1, 4] is revolved about the x-axis. 5

c) Find the volume of the solid generated when the region enclosed by $y = \sqrt{x}$, $y = 2$, and $x = 0$ is revolved about the y-axis. 5

6. a) Use cylindrical shells to find the volume of the solid generated when the region R in the first quadrant enclosed between $y = x$ and $y = x^2$ is revolved about the y-axis. 6

b) Find the exact arc length of the curve $y = 3x^{3/2} - 1$ from $x = 0$ to $x = 1$. 5

c) Evaluate the improper integral $\int_0^3 \frac{dx}{x-2}$. 4