Tribhuvan University

Institute of Science and Technology

2076

III Sem.
1

Subject: **Introduction to Programming II**
Course No: **MSCS 201**
Level: **B. Math. Sc. /II Year /III Semester**

Full Marks: 45
Pass Marks: 18
Time: 2hrs

Candidates are required to give their answer in their own words as far as practicable.

Attempt ALL Questions.

Group A [5 × 3 = 15]

1. List out features of OOP and explain any three of them.
2. Explain the purpose of constructor and destructor. Can we have more than one destructor in a class? Explain it.
3. Differentiate between Is-a rule and Has-a rule.
4. What are exceptions? Explain exception handling mechanism in c++.
5. What is virtual function? Explain its role in achieving runtime polymorphism with suitable example.

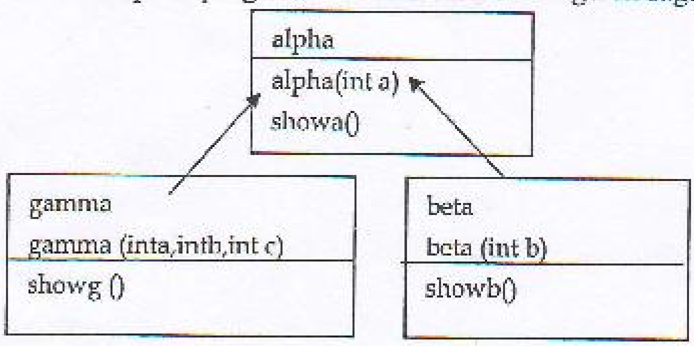
Group B [5 × 6 = 30]

6. WAP using friend function to add numerical values of three object of different classes.

OR

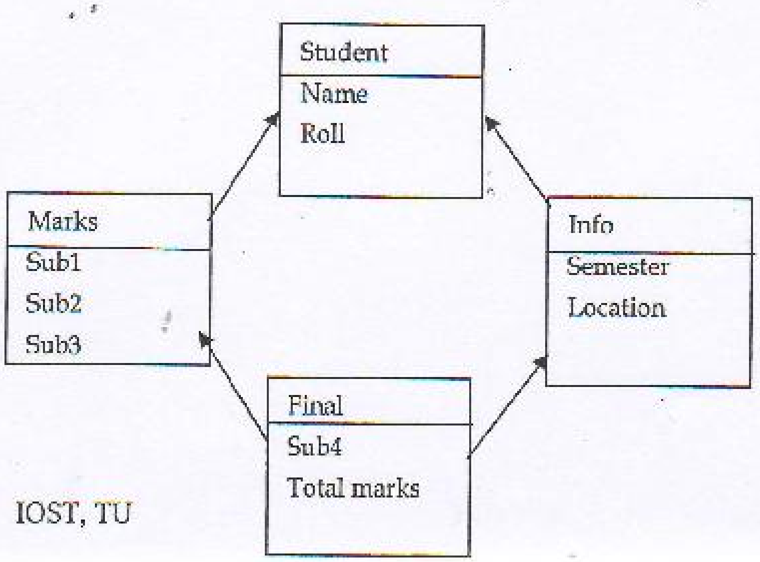
Write base class that ask the user to enter time (hour, minute and second) and derived class adds the time of its own with the base. Finally make third class that is friend of derived class and calculate the difference of base class time and its own time.

7. Write a complete program with reference to the given fugure:



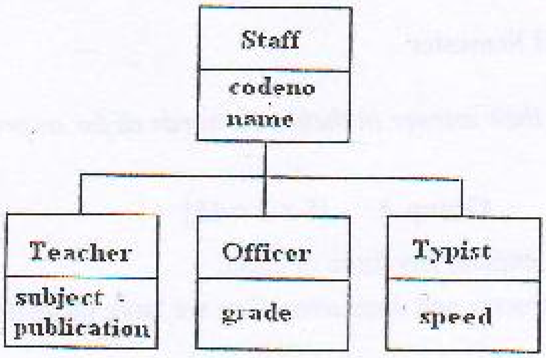
OR

Consider the following class network:



Write down the necessary code for the given network. Initialize the data members using constructors. The class named Final should display the all the information of all other classes Student, Info, Marks including the total marks.

8. An educational institution wishes to maintain records of its employees. The records are divided into a number of classes, whose hierarchical relationships are as in the figure below. The figure also shows minimum information required for each class. Specify all the classes and define functions to create the record and retrieve individual information as and when required.



9. Define a class My String to hold a string of characters. Overload the "+" operator to concatenate two objects of class My String and assign it to a third object ($s_1=s_2+s_3$).

10. Why type casting is important in OOP? Define two classes Time12 and Time24 that represents time in 12 hour and 24 hour format respectively. Write a program with conversion routine to convert time from one format to another.

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III Sem.
2

Subject: **Linear Algebra with Application II**
Course No: **MSMT 201**
Level: B. Math. Sc. /II Year/III Semester

Full Marks: 45
Pass Marks: 18
Time: 2hrs

Candidates are required to give their answer in their own words as far as practicable.

Attempt ALL Questions.

Group A [5 × 3 = 15]

1. State Cayley - Hamilton theorem. Also verify the theorem for the matrix $\begin{bmatrix} 1 & 0 & 2 \\ 0 & -1 & 1 \\ 0 & 1 & 0 \end{bmatrix}$.

2. Define Hermitian and skew Hermitian matrix. If A is Hermitian matrix show that iA is skew Hermitian. Also prove that B^*AB is Hermitian/ skew Hermitian according as A is Hermitian / skew Hermitian.

3. Write the methods for solving cubic equation. Solve the equation $28x^3 - 9x^2 + 1 = 0$ by using symmetric function of the roots.

4. Find the roots of the equation $x^4 + 11x^2 + 10x + 50 = 0$ by using radicals.

5. A watch dealer wishes to buy new watches and has two models M_1 and M_2 to choose. Model M_1 costs Rs.100 and M_2 costs Rs.200. In view of the showcase of the dealer, he wants to buy watches not more than 30 and can spend up to Rs.4,000. The watch dealer can make a profit of Rs.30 in M_1 and Rs.50 in M_2. How many of each model should he buy to obtain maximum profit? Formulate the problem by mathematically and solve graphically.

Group B [5 × 6 = 30]

6. Diagonalize the matrix A= $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$.

7. Write the procedure for solving a system $y' = Ay$ with a diagonalizable coefficient matrix A. Use it to solve the system $y_1' = 4y_1 + y_3$, $y_2' = -2y_1 + y_2$ and $y_3' = -2y_1 + y_3$. Find the solution that satisfies the initial conditions $y_1(0) = -1$ and $y_2(0) = 1$ and $y_3(0) = 0$.

OR

Write the procedure for solving a system by iteration method. Use it to solve the system

$3x + 12y - z = 28$, $x + 4y + 7z = 2$, $10x + 4y - 2z = 20$.

8. Reduce the cubic equation $ax^3 + 3bx^2 + 3cx + d = 0$ ($a \neq 0$) to the form of $Z^3 + 3HZ + G = 0$, where H and G have their usual meaning. Also solve the equation by Cardon's Method.

OR

Find the condition that the equation $x^3 + px^2 + qx + r = 0$ may have two roots equal but opposite signs. Also solve the equation $27x^3 + 42x^2 - 28x - 8 = 0$, whose roots are in G.P.

9. Solve the equation $2x^4 + 6x^3 - 3x^2 + 2 = 0$ by Descarte's method and $x^4 - 5x^2 - 6x - 5 = 0$ by reducing difference of the squares.

10. Write the simplex algorithm for maximization problems. Use it to maximize $p = 9x + 13y$ subject to constraints $2x + 3y \leq 18$, $2x + y \leq 10x$, $y \geq 0$.

Tribhuvan University
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Ⅲ Sem.
3

Subject: **Differential Equations**
Course No: **MSMT 202**
Level: **B. Math. Sc. /II Year/III Semester**

Full Marks: 45
Pass Marks: 18
Time: 2hrs

Candidates are required to give their answer in their own words as far as practicable.

Attempt ALL Questions.

Group A $[5 \times 3 = 15]$

1. Newton's law of cooling states that the temperature of an object changes at a rate proportional to the difference between the temperature of the object itself and the temperature of its surroundings (the ambient air temperature). Suppose that the ambient temperature is $75^\circ F$ and that the rate constant is $0.05(\min)^{-1}$. Write a differential equation for the temperature of the object at any time. Draw its direction field and find the general solution.

2. Define order and degree of a differential equation. Also solve the equation $x\dfrac{dy}{dx} + y = y^2 \log x$.

3. If y_1 and y_2 are two solutions of the differential equation $y'' + p(t)y' + q(t)y = 0$, then prove that $c_1y_1 + c_2y_2$ is also a solution for any value of c_1 and c_2. When these solutions form a fundamental set of solutions?

4. Define singular point of a differential equation $P(x)y'' + Q(x)y' + R(x)y = 0$. Find the singular points of the differential equation $xy'' + (1-x)y' + xy = 0$ and classify them. Also solve the Euler equation $x^2y'' + 5xy' + 4y = 0, x > 0$.

5. State and prove first shifting theorem of Laplace transform. Find the Laplace transform of $f(t) = t\cosh at$.

Group B $[5 \times 6 = 30]$

6. Suppose that an object is falling in the atmosphere near the sea level.
   a) Write a differential equation for the velocity of a falling object of mass m if the drag force is proportional to the square of the velocity.
   b) Determine the limiting velocity after a long time.
   c) If m=10kg, find the drag coefficient so that the limiting velocity is 49m/s.

7. Derive Euler Method for approximating the solution of the initial value problem $\dfrac{dy}{dx} = f(x, y), y(x_0) = y_0$. Apply Euler method to the initial value problem $\dfrac{dy}{dx} = 2x + y, y(0) = 1$ to approximate the solution y at $x = 0.2, 0.4, 0.6, 0.8$ and 1.0 using $h = 0.2$. Also calculate the error.

   OR

   Check the exactness condition for the equation $(x^2 + 2xy^2)dx + (2x^2y + y^2)dy = 0$. If it is exact, solve it. Also solve the equation $p^3x - p^2y - 1 = 0$, where $p = \dfrac{dy}{dx}$.

8. Use variation of parameter method to find the general solution of $y''' + y' = \sec t$.

   OR

Use method of undetermined coefficients to find the general solution and solve $y''' - 3y'' + 2y' = t + e^t, y(0) = 1, y'(0) = -\frac{1}{4}, y''(0) = -\frac{3}{2}$.

9. Define ordinary point. Solve by power series method: $(1 - x^2)y'' - 2xy' + 2y = 0$.

10. State convolution theorem of inverse Laplace transform and use it to find the inverse Laplace transform of $\frac{1}{s(s^2+4)}$. Use Laplace transform to solve $y'' + y' - 2y = t, y(0) = 1, y'(0) = 0$.

Tribhuvan University
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III Sem.
4

Subject: **General Logic**
Course No: **MSMT 203**
Level: **B. Math. Sc. /II Year /III Semester**

Full Marks: 45
Pass Marks: 18
Time: 2hrs

Candidates are required to give their answer in their own words as far as practicable.

Attempt ALL Questions.

Group A [5 × 3 = 15]

1. What are strong and weak arguments? Discuss the types of inductive argument with examples.

2. Define quality, quantity and distribution of a categorical proposition. Translate the following statements into standard categorical form:
   a) A tiger is a mammal.
   b) If a bear is hungry, then it is dangerous.
   c) Accountants are the only ones who will be hired.

3. Define the terms logically equivalent, contradictory and consistent for a statement. Test the argument for the validity using indirect truth table:
   $\sim O \Rightarrow T$ $\quad T \Rightarrow O$ $\quad O \Rightarrow \sim T$ $\quad \therefore O \wedge \sim T$

4. Show that the Constructive dilemma is a valid argument form. Use rules of inference to derive the conclusion of given symbolized argument:
   $\sim M \wedge N$ $\quad P \Rightarrow M$ $\quad Q \wedge R$ $\quad (\sim P \wedge Q) \Rightarrow S$ $\quad /S \vee T.$

5. Define bind and free variables. Write the given statements using predicates and quantifiers and find their negation.
   a) All Americans eat cheeseburgers.
   b) Some student in this class has visited Mexico.
   c) The sum of two positive integers is positive.

Group B [5 × 6 = 30]

6. What is an expository passage? Give an example of expository passage that is an argument. Define fallacy. What do you mean by formal and informal fallacy? Describe the fallacy of weak analogy with example.

OR

Discuss some non-arguments. How the explanations are different from arguments? Give an example of an explanation that can be interpreted as an argument. Also describe fallacy of appeal to vanity with an example.

7. Define categorical syllogism. When a categorical syllogism is in standard form? Define mood and figure of a categorical syllogism. Use Venn diagrams to determine whether the following standard categorical syllogisms are valid from the Boolean standpoint.
   a) All circular triangles are plane figures. All circular triangles are three-sided figures. Therefore, some three sided figures are plane figures.
   b) Some individuals who risk heart disease are people who will die young. Some smokers are individuals who risk heart disease. Therefore, some smokers are people who will die young.
   c) No AIDS victims are people who pose an immediate threat to the lives of others. Some kindergarten children are AIDS victims. Therefore, some kindergarten children are not people who pose an immediate threat to the lives of others.

8. Describe Truth Tree Method. Use it to determine the validity of given arguments:

a) $F \Rightarrow G$ $\quad \sim H \vee I$ $\quad (G \vee I) \Rightarrow J$ $\quad \sim J$ $\quad \therefore \sim (F \vee H)$.

b) $A \Rightarrow (B \vee C)$ $\quad B \Rightarrow D$ $\quad A$ $\quad \therefore \sim C \Rightarrow D$.

9. Use conditional proof or indirect proof and the rules of inference to establish the truth of the following tautologies.

a) $[P \Rightarrow (Q \Rightarrow R)] \Rightarrow [(P \Rightarrow Q) \wedge (Q \Rightarrow R)]$.

b) $(P \Rightarrow Q) \equiv [P \Rightarrow (P \wedge Q)]$.

OR

Write the differences between conditional proof and indirect proof. Use indirect proof to derive the conclusion of given arguments:

a) $\sim M \Rightarrow (N \wedge O)$ $\quad N \Rightarrow P$ $\quad O \Rightarrow \sim P$ $\quad /M$.

b) $H \Rightarrow (L \Rightarrow K)$ $\quad L \Rightarrow (K \Rightarrow \sim L)$ $\quad / \sim H \vee \sim L$.

10. Prove that

a) If n is a positive integer, then n is odd if and only if n^2 is odd.

b) If n is an integer, then $n^2 \geq n$.

State the rules of inference for quantified statements. Show that the premises "A student in this class has not read the book'' and "Everyone in this class passed the first exam" imply the conclusion "Someone who passed the first exam has not read the book''.

III Sem.
5

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Subject: **Theory of Probability**
Course No: **MSST 201**
Level: **B. Math. Sc. /II Year /III Semester**

Full Marks: 45
Pass Marks: 18
Time: 2hrs

Candidates are required to give their answer in their own words as far as practicable.

Attempt ALL Questions.

Group A [5 × 3 = 15]

1. The joint probability density function of two dimensional random variable (X, Y) is given by $f(x,y) = K(x+y)$, 0<x<1 and 0<y <1.
Find K, f(x), f(y), f(x/y) and f(y/x).

2. The table below shows a bivariate probability distribution for two discrete random variables X and Y

	X= 0	X= 1	X= 2
Y= 1	0.15	0.20	0.25
Y= 2	0.05	0.15	0.20

Find the value of E[Y/X= 2] and V[Y/X= 2].

3. Forty five percent of the Nepalese workers have been gone abroad are illegal. If in a sample of six, Nepalese workers who have gone abroad, what is the probability that two are illegal, all are legal and at least one is legal?

4. A machine is known to produce 5% defective items. A quality control engineer is examining the items (by taking them) at random. What is the probability that at least four items are to be examined in order to get 2 defectives? Also, find the mean and variance of the number of items to be examined in order to get 2 defectives?

5. Determine the mean, variance, coefficient of skewness and kurtosis of Weibull distribution with parameters α=2 and β=5. Also interpret your result.

Group B [5 × 6 = 30]

6. Find the variance of sample mean in case of simple random sampling with replacement and also show that $E(s^2) = \sigma^2$.

OR

In a population with N=6, the values of its elements are 1, 3, 8, 11, 7 and 4. In sampling without replacement of samples of size 2, prove that $E(\overline{x}) = \mu$, $E(s^2)= S^2$ and $S.E.(\overline{x}) = 2.117$.

7. The number of aero planes arriving at an airport is 10 per hour. Find the probability that the total number of aero planes to arrive during a 36 hours period is less than 370, at least 375. Also find a number C such that the probability that the average number of aero planes to arrive per hour will fall in the interval (10-C, 10+C) is 0.95.

OR

State and prove central limit theorem. A symmetric dice is thrown 360 times. Use Chebyshev's inequality to find the lower bound for the probability of getting 100 to 140 sixes.

8. Show that Poisson and Gamma distributions are the members of exponential family of distributions and also find their respective mean and variance.

9. Many manufacturing problems involve the accurate matching of machine parts such as shafts that fit into a valve hole. A particular design requires a shaft with a diameter of 22 mm, but shafts with diameters between 21.9 and 22.01 are acceptable. Suppose that the manufacturing process yields shafts with diameters normally distributed with a mean of 22.02mm and a standard deviation of 0.05 mm. for this process, what is

a) The proportion of shafts with a diameter between 21.90 and 22?
b) The probability of an acceptable shaft?
c) The proportion of shafts with a diameter more than 22.08?
d) The diameter that will be exceeded by only 2% of the shafts?

10. Suppose two random variables X and Y have joint density function

$$f(x, y) = k(4-x-y)\ ;\ 0<x<2,\ 0<y<2$$
$$= 0\ ;\ \text{otherwise}$$

Find the constant k, E(X/Y=1), E(Y/X=2) and V(X/Y=1). Also show that E[E(X/Y)]=E(X).