KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 2nd Term Examination, 2021
Department of Computer Science and Engineering
CSE 2201
Algorithm Analysis and Design

TIME: 3 hours FULL MARKS: 210

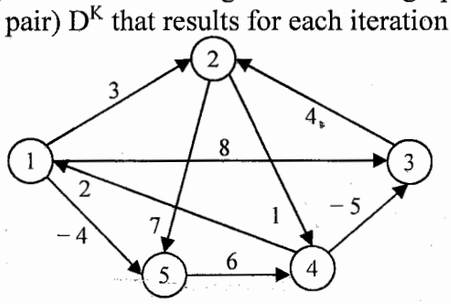
N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

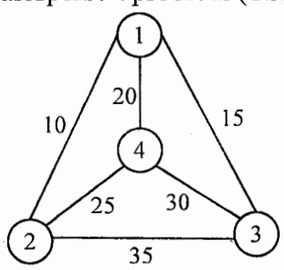
(Answer **ANY THREE** questions from this section in Script A)

1. a) Define Algorithm. What are the basic criteria that an algorithm must satisfy? (08)
   b) Write down the best $big\text{-}oh(O)$ characterization for each of the running time estimates of different algorithms: (i) $log(n) + 10000$, (ii) $50n + nlog(n^2) + 1000log(n)$, (iii) $2^{20} + 3^7$, and (iv) $6n^3/(log(n) + 1)$. (10)
   c) What are the differences between performance analysis and performance measurement of an algorithm? (05)
   d) Consider 0/1 knapsack problem where knapsack capacity(m) = 10, weight = {10, 3, 5} and profit = {40, 20, 30}. Now explain the application of dynamic programing and greedy algorithm to find an optimal solution. (12)

2. a) Consider a sum of subset problem with six items (n = 6) and sum(m) = 30. The items are $w[1:6]$ = {5, 10, 12, 13, 15, 18}. Now draw a state space tree for the above problem using backtracking approach. (09)
   b) Explain how the solution space is reduced from N^N to $N!$ in N-Queen problem. (06)
   c) What do you mean by parallel algorithm? Why do we need parallel algorithm? (07)
   d) Run the Floyd-Warshall algorithm on the weighted directed graph shown in the following figure. Show the matrix (All pair) D^K that results for each iteration of the outer loop. (13)

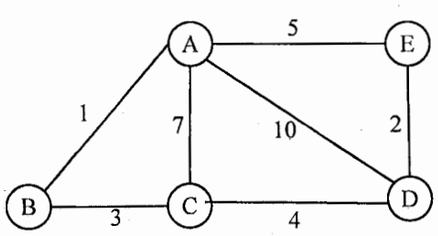


3. a) Why is the order of an algorithm generally more important than the speed of the processor? (06)
   b) Consider the following travelling salesperson problem (TSP): (12)



(i) Convert Multi-stage Graph. (ii) Find the minimum cost path in the multi-stage graph (From(i)). Do this using the backward reasoning approach.

   c) Consider the following undirected graph where the value of each edge represents the length of the that edge. (09)



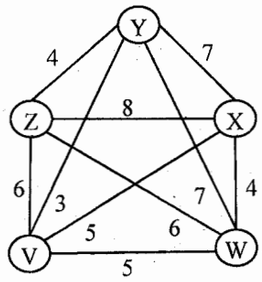
Apply Kruskal's algorithm, (i) What is the total length of the shortest path between A and D? (ii) What is the total length of the edges in a minimum spanning tree?

   d) What do you mean by backtracking? Write down the recursive backtracking algorithm to solve N-Queen problem. (08)

4. a) What is branch and bound technique? Which problem can be solved by branch and bound? (05)
   b) Consider the following table where P is the probability and K is the key value. Construct optimal binary search tree (OBST). (13)

K	1	2	3	4	5
$P(K)$	0.25	0.20	0.05	0.20	0.30

c) The branch-and-bound method is to be used to find a solution to the travelling salesman problem for the following graph.



What is the initial lower bound obtained by considering the rows and columns of the table of edge weights?

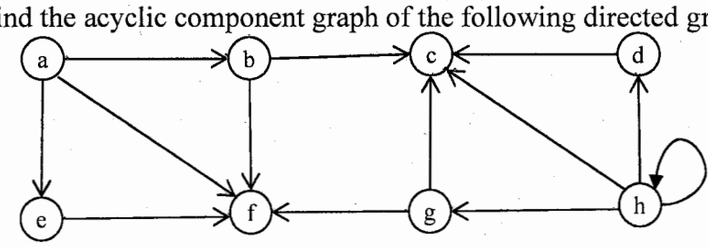
d) What is the running time in θ notation (as function of n) of the following code? Give an explanation. (05)

```
for x = 1 to n do
 begin
     y = x;
  while y>1 do
     y = y/2;
 end
```

SECTION B

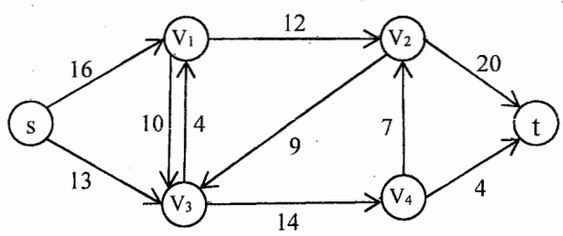
(Answer **ANY THREE** questions from this section in Script B)

5. a) Define SCC. Find the acyclic component graph of the following directed graph. (10)



b) Describe the properties of network flow. (06)

c) Apply Edmonds-Karp algorithm to find the maximum flow of the following network. Specify the augmenting path, flow-network and residual network after each step. (19)



6. a) Establish the relation among P, NP, NP-hard and NP-complete. (08)

b) Develop a nondeterministic polynomial time algorithm for sum of subset problem. Also, find the time complexity of it. (10)

c) Define CNF-SAT. Prove that CDP reduces to CNF-satisfiability by using the propositional formula $F = (x_1 \vee \bar{x}_3) \wedge (x_1 \vee \bar{x}_2) \wedge (x_2 \vee \bar{x}_3)$. Also find the clique. (13)

d) How can we show the relationship between SAT and exponential problem? (04)

7. a) Define approximation algorithm. Explain the different types of approximation algorithm with proper example. (14)

b) Let there are 5 jobs and 5 machines. Each job needs to be executed only one unit and can be completed by different machines. Each machine can execute only one job and a job can be appointed for only one machine. Find an assignment of machines for the following jobs in such that as many jobs as possible are executed. (13)

- J1(M2, M3)
- J2(M2)
- J3(M1, M4, M5)
- J4(M3)
- J5(M3, M4)

[N.B. J1(M2, M3) denotes J1 can be executed either M2 or M3]

c) "First-fit finds a 2-OPT solution" – Justify the statement. (08)

8. a) Define slack, makespan, utilization and tardiness. (08)

b) What are the basic requirements of a good hash function? Construct a hash table using the hash function, $h(k) = k \ mod \ 11$ by considering the following key-value pairs. If there is a collision, use open hashing technique to resolve this. (12)

Key	18	41	22	44	59	32	31	73	100	30
Value	10	20	30	40	50	60	70	80	90	100

c) Is there any problem in NP such that if we showed it to be in P, then that would imply that P = NP? If yes, prove that. (15)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 2nd Term Examination, 2021
Department of Computer Science and Engineering
CSE 2203
Microprocessors and Microcontrollers

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) How many registers are there in 8086? Describe them briefly. (10)
   b) If a code segment starts at address 1210H, then what will be the value of the IP register to point at the middle address of the code segment? What will be the value of the middle address? Consider the memory space as 16 MB. (10)
   c) What is addressing mode? Briefly describe the addressing modes of 8086 with examples. (10)
   d) Determine the maximum size of a memory that can be accessed by 32 bits address bus. (05)

2. a) Why 8086 is called a 16-bit microprocessor? Explain with an example. (05)
   b) Write down the corresponding machine codes for 8086 of the following instructions: (12)
      i) MOV AL, CH
      ii) MOV SP, 04[BP]
   c) Write an assembly code to compare two strings using "CMPSB" instruction where the strings have (12)
      i) Equal length.
      ii) Different length.
   d) Determine the number of bits needed to address an "N" MB memory. (USE $N = 2$, if your roll number is odd, otherwise use $N = 4$) (06)

3. a) Describe elaborately the types of jump instructions available in 8086 with examples. (08)
   b) Consider a stack which starts at location 5000H and has a size of 80 bytes. Now draw the stack by showing SP register for each of the following consecutive operations: (12)
   (i) push 6, (ii) push 17, (iii) pop, (iv) push 5483, (v) push 456, and (vi) pop.
   c) Write an assembly code to design a stack with 100 bytes space and then determine the value of "Top of the Stack (ToS)" while SS register is located at 7000H. (08)
   d) "Registers can be used for indirect far call" – Do you agree with this statement? Justify your answer. (07)

4. a) Show that a stack can be used to pass the parameters while converting the BCD of 13H to its corresponding binary number. (10)
   b) Consider a processor with a clock speed of 10 MHz. Now determine the value of N for the following program to generate a 600μs delay. (15)

```
      MOV CX, N
Here: NOP
      NOP
      NOP
      NOP
LOOP  Here
```

   c) "CMP instruction is an application of subtraction operation" – Justify the statement. (05)
   d) Differentiate between microprocessor and microcontroller with figures. (05)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Explain 8051 μC with its architecture, include figure. (10)
   b) What are the available timer modes in 8051 μC. Write down the steps and instructions to achieve a counter with value ABCD H. Make sure it can be controlled by an external source also. (10)
   c) Design a traffic light system using 8051 microcontroller. (15)
      i) Provide necessary pin diagram with brief explanation.
      ii) Write the program using C language.

6. a) How do 8086 and 8087 operate combinedly in a system? (08)
   b) Why do we need a math coprocessor? Convert -4321.875 in temporary (80 bits) real format (double extended precision). (10)
   c) Describe the control register of 8087 NDP. (10)
   d) Write down the key features of 80386 microprocessor. (07)

7. a) Suppose you need to transfer a large amount of data from hard disk to memory. Describe which technique and how it works for efficient data transfer. Include necessary figure(s). (12)
   b) Explain demand segmentation and demand paging with figures. If a page is not found in the logical memory, then how it is handled? Explain with figures. (12)
   c) The Intel's first 32 bit processor MMU has a selector (16 bits) and offset (32 bits). Explain how much virtual space can be accessible using both segmentation and paging. What is the advantage of paging in this scenario? (11)

8. a) Tabulate the value of signals A_0, $\overline{BHE}$, Memory Banks, location accessed, $D_0 - D_7$, $D_8 - D_{15}$ for the following transfer operations: (13)
      i) Microprocessor writes a byte 11H into location 1000 : 0003H
      ii) Microprocessor writes a word 2211H into location 1000 : 0003H
      iii) Microprocessor writes a byte 11H into location 1000 : 0004H
      iv) Microprocessor writes a word 2211H into location 1000 : 0004H
   b) Describe how task can be isolated in a multitasking enabled processor like 80386? (07)
   c) Explain how serial communication can be established in 8051 microcontroller with SBUF and SCON register. (10)
   d) Briefly describe how power save and power down mode work in 80186 microprocessor. (05)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 2nd Term Examination, 2021
Department of Computer Science and Engineering
CSE 2207
Numerical Methods

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define natural cubic splines. For cubic spline, derive the following equation where the different symbols have their usual meaning. (20)

$$h_i a_{i-1} + 2(h_i + h_{i+1})a_i + h_{i+1}a_{i+1} = 6\frac{f_{i+1} - f_i}{h_{i+1}} - \frac{f_i - f_{i-1}}{h_i}$$

b) Decide the degree of the polynomial represented by the following data using divided difference table and justify your answer. (10)

i	0	1	2	3	4
x_i	1	2	3	4	5
$f(x_i)$	0	7	26	63	124

c) What is the major pitfall of using Lagrange polynomial? (05)

2. a) What are Lagrange basis polynomials? Prove that when $n = 2$ data points, Lagrange interpolation reduces to the linear interpolation using proper equations. (14)
b) In CSE 2207 term final exam, the number of students who secured marks between certain interval were as follows: (13)

Marks	0 – 41	42 – 83	84 – 125	126 – 167	168 – 209
No. of Students	19	27	43	22	9

Estimate the number of students whose marks are less than 160 using Newton's backward interpolation formula.
c) Define condition number. What is it's significance to numerical computing? (08)

3. a) What is superlinear convergence? Show that the order of convergence of the Secant method is 1.618 using appropriate equations. (15)
b) Use zero-through fourth-order Taylor series expansion to predict $f(2)$ for $f(x) = lnx$ using a base point at $x = 1$. Compute the true percent relative error ε_t for each approximation and interpret the meaning of the overall results. (12)
c) What is machine epsilon? How is it related to significant digits? (08)

4. a) The following table gives the velocity of an object at various points in time. (15)

Time, t (min)	1	2	3	4
Velocity, V $(meter/min)$	70	83	100	124

If the relationship between the time t and velocity V is of the form $V = pe^{t/4} + q$, then estimate the velocity at $t = 6$ min.
b) A calculator is defective: it can only add, subtract, and multiply. Use the equation $1/x = 1.37$, the Newton-Raphson Method and the defective calculator to find $1/1.37$ correct to 8 decimal places. (12)
c) Discuss the situations where the fixed-point iteration process may not converge to a solution. (08)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) What do you mean by quadrature? How is the problem of numerical integration solved? Explain. (10)
b) Derive the General Quadrature Formula for Equidistant Ordinates and using this show the formula for Simpson's one-third rule. (15)
c) Evaluate the value of the integral $\int_{0.2}^{1.4}(sinx - log_e x + e^x)dx$ by Simpson's $\frac{1}{3}$ rule. After finding the value of the integral, compare the errors. (10)

6. a) What do you mean by arbitrary constant for the case of differential equation? Explain with example. (10)
   b) Use Runge-Kutta quadratic method to calculate three additional points on the solution curve of the problem. (13)
   $\frac{dy}{dx} = 1 - 2xy, y(0) = 0, h = 0.1$
   c) Derive the equations for the Euler's method. (12)

7. a) State two real-life problems where partial differential equations are required to construct mathematical models. (10)
   b) Derive the five-point formula for Laplace's equation. (15)
   c) Solve the equation (10)
   $2f_{xx}(x,t) = f_t(x,t), 0 < t < 1.5$ and $0 < x < 4$
   given the initial condition
   $f(x,0) = 50(4-x), 0 \leq x \leq 4$
   and the boundary conditions
   $f(0,t) = 0, 0 \leq t \leq 1.5$
   $f(4,t) = 0, 0 \leq t \leq 1.5$

8. a) Find the inverse of $A = \begin{bmatrix} 1 & 3 & 3 \\ 1 & 4 & 3 \\ 1 & 3 & 4 \end{bmatrix}$ (10)
   b) Solve the equations (10)
   $$2x + 3y + z = 9$$
   $$x + 2y + 3z = 6$$
   $$3x + y + 2z = 8$$
   by Gauss-Seidel iteration method.
   c) Solve the equations (15)
   $$2x - 6y + 8z = 24$$
   $$5x + 4y - 3z = 2$$
   $$3x + y + 2z = 16$$
   by factorization method.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 2nd Term Examination, 2021
Department of Computer Science and Engineering
HUM 2207
Economics and Accounting

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) What are the central economic problems of any economy? (10)
   b) Explain opportunity cost with the help of production possibility curve. (10)
   c) Draw a demand curve by a demand function i. e. $Q = \frac{12}{P}$ and find elasticity of demand at any point of it. (15)

2. a) Explain with the help of a diagram, how a producer gets maximum output with a given cost. (10)
   b) How does a perfect competitive firm achieve equilibrium in the short run? (15)
   c) Explain TFC & TVC. (10)

3. a) Distinguish between GDP & GNP. (10)
   b) What GDP deflator? Why do the economists prefer real GDP as a measure of economic well-being? (15)
   c) Describe the circular flow of National Income. (10)

4. a) "The main problem of economics is the application of scarce resources to solve unlimited problems" –discuss. (15)
   b) What is monetary policy? Explain the instruments of monetary policy. (20)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) What is meant by accounting cycle? Describe the steps of accounting cycle. (15)
   b) Describe the characteristics of transaction. (10)
   c) State the rules for determining debit and credit. (05)
   d) Who are the users of accounting information? (05)

6. On 1st January 2021 Mr. Mamun established the ABC travel Agency. The following transaction were completed during the month:

2021, January-	1	Mr. Mamun invested cash TK 2,00,000 in the name of Agency.
"	2	Paid TK 5,000 cash for January office rent.
"	3	Purchased office equipment for TK 25,000 cash.
"	4	Incurred advertising expenses of TK 3,000 in the "Daily Ittefaq" on account.
"	5	Paid TK 6,000 cash for office supplies.
"	6	Earned TK 1,00,000 for service rendered: cash received TK 40,000 from customers and the balance of TK 60,000 is billed to customers on account.
"	8	Paid the "Daily Ittefaq" amount due in transaction January 4.
"	9	Withdrew cash TK 4,000 for personal use.
"	10	Paid salaries to employees TK 15,000.
"	12	Received TK 60,000 in cash from customers who have previously been billed in transaction January 6.

Required: a) Prepare journal. (20)
b) Prepare a tabular analysis of the transactions using the following column headings: Cash; Accounts receivable; Supplies; Office equipment; Accounts payable; and Mamun's capital. (15)

7. a) How does a Trial Balance differ from a Balance Sheet? (05)
   b) Describe the errors that cannot be detected by a trial balance. (10)
   c) From the following ledger balances of STAR service, prepare a Trial Balance as on 31st December 2020: (20)

   Cash ------ TK 6,000, Prepaid Insurance ------ TK 6,600,
   Office Equipment ------ TK 2,800, Machine ------ TK 1,36,000,
   Depreciation expense ------ TK 2,100, Accounts Receivable ------ TK 1,200,
   Accumulated dep. – office equipment ------ TK 100, Capital ------ TK 72,000,
   Accumulated depreciation – machine ------ TK 2,000, Fees earned ------ TK 23,600,
   Notes payable ------ TK 60,000, unearned fees ------ TK 10,500,
   Salaries expense ------ TK 11,500, Advertising expense ------ TK 800,
   Gas and Oil expense ------ TK 2,100, Interest expense ------ TK 700,
   Salaries payable ------ TK 1,500, Insurance expense ------ TK 600,
   Interest payable ------ TK 700.

8. The unadjusted trial balance of Vasan construction as on December 31, 2020 is presented below: (35)

VASAN CONSTRUCTION Trial Balance as on 31st December 2020		
Accounts Titles	Debit (TK)	Credit (TK)
Cash	12,000	
Accounts Receivable	24,000	
Supplies	18,800	
Prepaid Insurance	12,400	
Equipment	1,62,000	
Accumulated depreciation – equipment		40,500
Accounts payable		9,600
Long term notes payable		30,000
Vasan's capital		76,000
Vasan's Drawings	72,000	
Construction fees earned		2,80,000
Wages	82,000	
Interest expense	3,000	
Rent expense	26,400	
Property tax expense	10,000	
Repair expense	5,700	
Utilities expense	7,800	
	4,36,100	4,36,100

Additional data:

i) Supplies used during the year TK 12,800.
ii) The balance of prepaid insurance on December 31, 2020 TK 4,400.
iii) Annual depreciation on equipment is TK 14,000.
iv) The December utilities expense of TK 8,000 was not included in the trial balance because the bill arrived after it was prepared.
v) Make allowance for doubtful debts @ 5% on accounts receivable.

Required:

a) Prepare the comprehensive income statement for the year ended December 31, 2020.
b) Prepare owner's equity statement and
c) Prepare the financial position as on 31-12-2020.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 2nd Term Examination, 2021
Department of Computer Science and Engineering
MATH 2207
Complex Variable, Vector Analysis and Statistics

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Derive the relation between 3rd central moment and raw moments (measured from origin) from general formula. (07)

b) The frequency distribution are given below: (28)

Income (in Tk)	50 – 60	60 – 70	70 – 80	80 – 90
No. of workers	4	9	14	24

From the above frequency distribution
(i) Determine 1st four raw moments (measured from origin),
(ii) Determine 1st four central moments,
(iii) Determine the coefficient of Skewness and Kurtosis and comments on the nature of the distribution.

2. a) Three fair coins are flipped. Define random variable x as 4 times of the number of upper face of head minus 3. Now, express the probability distribution of the random variable for these flipped coins. Hence find mean and coefficient of variation. Also find the probability $p(x < 0)$. What is/are the actual values (i.e., number of upper face of head) for each $x < 0$? (13)

b) Test whether the following function is probability density function or not for some value of K. (14)

$$P(x) = \begin{cases} K & if\ 3 \le x \le 4 \\ 0 & otheriwise \end{cases}$$

Hence, if possible, find $E(2x^2 - 3x + 4)$ and $P(-2 < x < 2)$.

c) Define Bernoulli trials and Poisson process with example. (08)

3. a) A system analyst observed the following data: (10)

No. of virus	0	1	2	3	≥ 4
Attack in each 2 minutes time interval	2	3	0	9	0

If 5 virus/min is the threshold value, then
(i) Find the probability of number of virus exceed the threshold value.
(ii) Find the probability that 20 viruses attack within the duration 10.30 - 11.00.

b) Write down the probability density function of standardized normal variate. Then prove that this is a continuous probability density function. (10)

c) Write down five properties of standardized normal distribution. (05)

d) The mean weight of 2500 students of KUET is 45 kg with S.D. 9 kg. Assume that the weights are normally distributed. Find how many students weight (10)
(i) Between 40 to 50 kg.
(ii) More that 50 kg (over weight).
(iii) Less that 35 kg (under weight).

4. a) Find (i) The unit tangent vector, (ii) The curvature, (iii) The principal normal, (iv) The binormal for the space curve $x = t - \frac{t^3}{3}$, $y = t^2$, $z = t + \frac{t^3}{3}$. (13)

b) Find the eigen values of the unequal scaling matrix operator of dimension 2 such that vector is enlarged two times along x direction and 3 times along y direction. Also illustrate the effect of that operator on the geometrical figure whose corner points are (1,1), (1,3), (2,1), (2,3). (10)

c) Write down the relation in direction cosine between two cartesian coordinate systems (x, y, z) and (x', y', z') which have same origin but rotated an angle θ. Given a vector $(1, 1, 1)^t$, using 4×4 matrix operator, shift it uniformly 3 units in positive direction, then using 3×3 matrix rotational operator, rotate it 90° in anti-clockwise about x axis and finally scale it unequally with 2, 3 and 4 along x, y, and z axis respectively. Draw original and modified vectors after each operation. If the order of matrix operators are changed – are the modified points have same position as previous one, why? (12)

SECTION B

(Answer **ANY THREE** questions from this section in Script B)

5. a) Find each of the indicated roots and locate them graphically for $(2\sqrt{3}-2i)^{1/3}$. (08)
   b) What do you mean by singularities of infinity? Locate and identify all the singularities of the following function: (i)$f(z)=\frac{ln(z-3)}{(z^2+2z+3)^4}$, and (ii) $f(z)=sin^{-1}\left(\frac{1}{z}\right)$. (14)
   c) Prove that an analytic function with constant modules is constant. (07)
   d) Write down the necessary and sufficient condition of a function to be analytic. (06)

6. a) Define harmonic function. Prove that $u=3x^2y+2x^2-y^3-2y^2$ is harmonic function. Find v, such that $f(z)=u+iv$ is analytic function, where v is harmonic conjugate. (15)
   b) Evaluate $\oint_C \frac{sin\pi z^2+cos\pi z^2}{(z-1)(z-2)}.dz$, where C is circle $|z|=3$. (12)
   c) Prove that $|z_1+z_2|\leq|z_1|+|z_2|$. (08)

7. a) Find an equation of tangent plane and normal vector to the surface $f_1: 3x^2z-3zy-4z=4$ at the point $(1,-1,2)$. Also find the angle between the two surfaces f_1 and f_2 at that point, where $f_2: x^2+y^2+z^2=6$. (14)
   b) Show that $\underline{F}=(2xy+z^3)\underline{i}+x^2\underline{j}+3xz^2\underline{k}$ is a conservative force field. Find the scalar potential. (09)
   c) Evaluate $\nabla.\left(\frac{\bar{r}}{r}\right)$ and $\nabla^2\left(\frac{1}{r^2}\right)$. (12)

8. a) Find the total work done in moving a particle in a force field given by $\underline{F}=3xy\underline{i}-5z\underline{j}+10z\underline{k}$ along the curve $x=t^2+1, y=2t^2, z=t^3$, from $t=1$ to $t=2$. (12)
   b) Evaluate $\iint_S \underline{A}\cdot\underline{n}\,ds$, where $\underline{A}=18z\underline{i}-12\underline{j}+3y\underline{k}$ and S is that of plane $2x+3y+6z=12$ which is located in the first octant. (13)
   c) Find the volume of the region common to the intersecting cylinders $x^2+y^2=a^2$ and $x^2+z^2=a^2$. (10)