Total No. of Questions : 5] **[Total No. of Pages : 3**

P877

[3635] - 101

M.Sc. Tech. - (Part - I)

MATHEMATICS

Industrial Mathematics with Computer Applications

MIM - 101 : Real Analysis

(Old & New Course) (Semester - I)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any Eight of the following: **[16]**

a) Let $\bar{x}, \bar{y} \in R^k$. Show that $\left|\|\bar{x}\| - \|\bar{y}\|\right| \leq \|\bar{x} - \bar{y}\|$, where $\|\bar{x}\|$ denotes the norm of $\bar{x} \in R^k$.

b) Show that any closed ball in R^k is a convex set.

c) Let E be a non - empty set of real numbers which is bounded above. Let $y = \sup E$. Prove that $y \in \overline{E}$, the closure of E.

d) Let f be a continuous real valued function on a metric space X.

Let $A = \{p \in X / f(p) \geq 0\}$. Prove that A is a closed set in X.

e) Let $\{S_n\}$ be a sequence of reals such that $\{|S_n|\}$ converges to 0. Show that $\{S_n\}$ converges to 0.

f) Show that every Cauchy sequence in the discrete metric space R_d is convergent.

g) Find the radius of convergence of the power series $\sum_{n=1}^{\infty} \frac{z^n}{n!}$, $(z \in C)$.

h) If F is a closed set and K is a compact set, prove that $F \cap K$ is compact.

i) Give an example of a differentiable function whose first derivative is not continuous?

j) If $f(x) = x^3 + 1$, $\alpha(x) = x^2$, then evaluate $\int_0^1 f \, d\alpha$.

P.T.O.

Q2) a) Attempt any ONE of the following: **[6]**

i) Let E be an infinite subset of a compact set K. Prove that E has a limit point in K.

ii) Let f be a monotonic function on (a, b) Show that the set of points of (a, b) at which f is discontinuous is at most countable.

b) Attempt any TWO of the following: **[10]**

i) Define a compact subset of a metric space. Prove that a closed subset of a compact set is compact.

ii) Let $\{S_n\}$ be a sequence of reals defined by $S_1 = \sqrt{5}$, $S_{n+1} = \sqrt{5S_n}$, $\forall n \geq 1$. Show that the sequence $\{S_n\}$ is monotonic and bounded in R'.

iii) Let $\{p_n\}$ be a Cauchy sequence in a metric space X. If for each $n \in N$, $E_n = \{p_n, p_{n+1}, p_{n+2}, \text{- - - - - -}\}$ then show that $\lim_{n\to\infty}(\text{diam } E_n) = 0$.

Q3) a) Attempt any ONE of the following: **[6]**

i) Let $\sum a_n$ be a series of real numbers and let $\lim_{n\to\infty} \sup |a_n|^{1/n} = A$. Prove that if A < 1, then $\sum a_n$ converges and if A > 1, then $\sum a_n$ diverges.

ii) Show that a mapping f of a metric space X into a metric space y is continuous on X if and only if $f^{-1}(G)$ is open in X, whenever G is open in Y.

b) Attempt any TWO of the following: **[10]**

i) Let f be a continuous mapping of a metric space X into a metric space Y. Let E be a connected subset of X. Show that $f(E)$ is connected in Y.

ii) If (a) $|c_1| \geq |c_2| \geq |c_3| \geq \ldots\ldots$

(b) $c_{2m-1} \geq 0$, $c_{2m} \leq 0$, $m = 1, 2, 3 \ldots\ldots$

(c) $\lim_{n\to\infty} c_n = 0$, then prove that the series $\sum c_n$ converges.

iii) Let f be a continuous one-one mapping of a compact metric space X onto a metric space Y. Show that the inverse mapping f^{-1} on Y defined by $f^{-1}(f(x)) = x$, $(x \in X)$ is a continuous mapping of Y onto X.

Q4) a) Attempt any ONE of the following: **[6]**

i) Let f be monotonic on $[a, b]$. Let α be monotonic and continuous on $[a, b]$. Prove that $f \in R(\alpha)$ on $[a, b]$.

ii) Let $f \in R[a, b]$. If there is a differentiable function F on $[a, b]$ such that $F' = f$, prove that $\int_a^b f(x)dx = F(b) - F(a)$.

b) Attempt any TWO of the following: **[10]**

i) Let $f \in R(\alpha)$ on $[a, b]$, where α is monotonically increasing on $[a, b]$. Prove that $|f| \in R(\alpha)$ on $[a, b]$ and that $\left|\int_a^b f d\alpha\right| \leq \int_a^b |f| d\alpha$.

ii) Let f be a real differentiable function on $[a, b]$ and suppose that $f'(a) < \lambda < f'(b)$. Prove that there is a point $x \in (a,b)$ such that $f'(x) = \lambda$.

iii) Let $\bar{f}:[a,b] \to R^k$ be continuous on $[a, b]$ and let $\bar{f}$ be differentiable on (a, b). Show that there exists $c \in (a, b)$ such that

$$\left\|\bar{f}(b) - \bar{f}(a)\right\| \leq (b-a)\left\|\bar{f}'(c)\right\|.$$

Q5) Attempt any FOUR of the following: **[16]**

i) Let $\{S_n\}$ be a monotonic sequence of reals. Show that $\{S_n\}$ converges if and only if $\{S_n\}$ is bounded.

ii) Let $E = [0, \infty)$. Let $f_n(x) = \frac{x}{1+nx}$, $\forall x \in E$. Let $f(x) = 0$, $\forall x \in E$. Show that the sequence $\{f_n\}$ of functions converges uniformly to the function f on E.

iii) Let $f_n(x) = n^2x\,(1 - x^2)^n$, $\forall x \in [0, 1]$, $n = 1, 2, 3$. Show that

$$\lim_{n\to\infty} \int_0^1 f_n(x)dx \neq \int_0^1 \lim_{n\to\infty} f_n(x)dx.$$

iv) Discuss uniform convergence of the series $\sum_{n=1}^{\infty} \frac{1}{n^3 + n^4x^2}$ on R.

v) Let f be a continuous map of a metric space X into a metric space Y. For every $E \subseteq X$ prove that

$f(\bar{E}) \subseteq \overline{f(E)}$ where $\bar{E}$ denotes the closure of E.

Total No. of Questions : 5] **[Total No. of Pages : 3**

P878

[3635] - 102

M.Sc. Tech. - I

MATHEMATICS

MIM - 102 : Algebra - I

(Old & New Course)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***

2) ***Figures to the right indicate full marks.***

Q1) Attempt any eight of the following: **[16]**

i) Let S = {0} UN, the set of non-negative integers. Define $*$ on S as : For $a, b \in S$

$a * b = |a - b|$. Is $\langle S, * \rangle$ a group? Justify.

ii) Say true or false : "Every proper subgroup of a group of order 77 is cyclic". Justify.

iii) Let G be a group of all 2 x 2 non-singular matrices with real entries, under matrix multiplication. Show that $H = \left\{ \begin{bmatrix} a & 0 \\ 0 & a \end{bmatrix} \middle| a \neq 0 \text{ in } R \right\}$ is a normal subgroup of G.

iv) Find the order of S_n/A_n, where S_n is a group of permutation on n-symbols and A_n, the alternating group of degree n.

v) Find the generators of cyclic group $G = < a >$ generated by a of order 20.

vi) Find the number of conjugate classes in S_4.

vii) Give an example of a ring which is an integral domain but not a field.

viii) If R is a ring with unity 1 and ϕ is a ring homomorphism of R onto R', prove that, $\phi(1)$ is the unity of R'.

ix) Show that a field has only trivial ideals.

x) Is $X^3 - 9$ irreducible over the ring of integers modulo 7?

P.T.O.

Q2) a) Attempt any <u>one</u> of the following: **[6]**

i) State and prove the necessary and sufficient conditions for a nonempty subset H of a group G to be a subgroup.

ii) Prove that a subgroup N of G is normal subgroup of G if and only if the product of two right cosets of N in G is again a right coset of N in G.

b) Attempt any <u>two</u> of the following: **[10]**

i) Prove that every group of prime order is cyclic.

ii) Show that the alternating group A_n of degree n is normal subgroup of S_n.

iii) In a group G, if $a^5 = e$, $aba^{-1} = b^2$, $b \neq e$, for some $a, b \in G$, then find the order of b.

Q3) a) Attempt any <u>one</u> of the following: **[6]**

i) State and prove the first fundamental theorem of homomorphism.

ii) State and prove Cayley's theorem.

b) Attempt any <u>two</u> of the following: **[10]**

i) Find the order of the permutation σ, where

$$\sigma = (5, 1, 3, 6)\ (6, 7, 5)\ (1, 2, 3).$$

ii) Prove that 'conjugacy' is an equivalence relation among the elements of group G.

iii) Prove that $C^* / T \approx R^+$, where C^* is the group of non-zero complex numbers under multiplication, R^+ is the group of positive reals under multiplication and T be the group of complex numbers whose absolute value is 1, under multiplication.

Q4) a) Attempt any <u>one</u> of the following: **[6]**

i) Let R be a Euclidean ring. Prove that, any two elements a and b in R have a greatest common divisor 'd'. Also show that $d = \lambda a + \mu b$, for some $\lambda, \mu \in R$.

ii) Prove that every finite integral domain is a field.

b) Attempt any two of the following: **[10]**

i) Show that intersection of two ideals is again ideal. What about union?

ii) If R is a commutative ring with unit element and M is an ideal of R, then show that M is maximal ideal of R if and only if R/M is a field.

iii) Prove that the homomorphism ϕ of a ring R onto the ring R' is an isomorphism if and only if Kernel of ϕ is $\{0\}$.

Q5) a) Attempt any one of the following: **[6]**

i) State and prove the division algorithm for polynomial ring F[x], where F is field.

ii) Prove that if R is integral domain then so is R[x].

b) Attempt any two of the following: **[10]**

i) Find all units in the ring of Gaussian integers Z[i]. Further, if $a + ib$ is not a unit in Z[i], show that $a^2 + b^2 > 1$.

ii) If p is prime number, show that the polynomial $f(x) = 1 + x + - - - + x^{p-1}$ is irreducible over rationals.

iii) Find the greatest common divisor of the polynomials $x^2 + 1$ and $x^6 + x^3 + x + 1$ over the rationals.

Total No. of Questions : 5] **[Total No. of Pages : 4**

P879

[3635] - 103

M.Sc. Tech. (Part - I)

MATHEMATICS

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 103 : Discrete Mathematical Structures - I

(New Course) (Semester - I)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any EIGHT of the following: **[16]**

a) Using a truth table, show that $(p \wedge q) \rightarrow (p \rightarrow q)$ is a tautology.

b) Express the statement:-

"No student in your class has a car and a dog" in symbolic form, if the domain consists of all students in your class.

c) Is $(D_{24}, /)$ a Boolean algebra? Justify : / denotes divisibility.

d) Find the duals of the Boolean expressions:

i) $xyz + \bar{x}\,\bar{y}\,\bar{z}$.

ii) $x\,\bar{z} + x \cdot 0 + \bar{x} \cdot 1$

e) Let R be a relation defined on Z by aRb if and only if 'a divides b'. Is R antisymmetric? Justify.

f) Let $A = \{a, b\}$. Does the following table define a semigroup on A? Justify.

*	a	b
a	a	b
b	a	a

g) Let R be the equivalence relation defined on the semigroup (Z, +) by aRb iff '$a + b$ is even'. Is R a congruence relation on Z? Justify.

h) How many different three letter initials are there that begin with an A?

i) How many subsets with more than 2 elements does a set with 100 elements have?

j) How many positive integers not exceeding 1000 are divisible by 7 and 11.

P.T.O.

Q2) a) Attempt any ONE of the following: **[6]**

i) Show that the hypotheses:

"If you send me an e-mail message, then I will finish writing the program"; "If you do not send me an e-mail message, then I will go to sleep early" and "If I sleep early. Then I will wake up feeling refreshed", lead to the conclusion: "If I do not finish writing the program, then I will wake up feeling refreshed".

ii) Give the converse, inverse and contrapositive of the statement:

"The sun shines only if I am happy".

b) Attempt any TWO of the following: **[10]**

i) Determine the truth value of each of the following statements, if the domain consists of all integers:

a) $\forall n\ (n+1>n)$ b) $\exists n,(n+1<n)$

c) $\exists n(n=-n)$ d) $\forall n\left(n^2 \geq n\right)$

e) $\exists n(2n=3n).$

ii) Prove that $\sqrt{2}$ is irrational, by giving a proof by contradiction.

iii) Show that $(p \rightarrow q) \wedge (p \rightarrow r)$ and $p \rightarrow (q \wedge r)$ are logically equivalent.

Q3) a) Attempt any ONE of the following: **[6]**

i) Prove that the homomorphic image of a relatively complemented lattice is relatively complemented.

ii) Show that the product of two lattices is a lattice.

b) Attempt any TWO of the following: **[10]**

i) Construct a circuit gate diagram to produce the following outputs:

$(\alpha)\ (x+y)\bar{x}$ $(\beta)\ (x+y+z)\ \bar{x}\,\bar{y}\,\bar{z}$

ii) Prove that a distributive lattice is modular. Is the converse true? Justify.

iii) Draw the Hasse diagram for the lattice $D_8 \times D_{27}$.

Q4) a) Attempt any ONE of the following: **[6]**

i) Let B be a Boolean algebra. In usual notation, prove that

$$\overline{x \wedge y} = \bar{x} \vee \bar{y}\,.$$

ii) Use the Quine - Mc Cluskey method to simplify the following sum-of- products expression

$$x\,y\,z + x\,y\,\bar{z} + \bar{x}\,y\,z + \bar{x}\,y\,\bar{z}\,.$$

b) Attempt any TWO of the following: **[10]**

i) Show that D_{30} with respect to 'divisibility' is a complemented lattice. Find all atoms of D_{30}.

ii) Construct a Karnaugh map for

$$F(x, y, z) = x\,y\,\bar{z} + x\,\bar{y}\,\bar{z} + \bar{x}\,\bar{y}\,z + \bar{x}\,\bar{y}\,\bar{z}$$

iii) Let (S, $*$) and $(S', *')$ be monoids with identity elements e and e'. Let $f : S \to S'$ be an epimorphism. Show that $f(e) = e'$.

Q5) a) Attempt any ONE of the following: **[6]**

i) Let (S, $*$) be a semigroup. Let R be a congruence relation on S. Define $\circledast$ on S/R as follows:

$$[a] \circledast [b] = [a * b],\ \forall\ [a], [b] \in S/R.$$

Show that $\circledast$ is well defined in S/R and that (S/R,$\circledast$) is a semigroup.

ii) Let (S, $*$), $(T, *')$ be semigroups. Show that the function $f : S \times T \to S$ defined by $f(s, t) = s\ \forall (s,t) \in S \times T$, is a homomorphism of the semigroup S $\times$ T onto the semigroup S.

b) Attempt any TWO of the following: **[10]**

i) Show that for every integer 'n', there is a multiple of 'n' that has only 0's and 1's in its decimal expansion.

ii) How many strings of eight English letters are there

(α) that start with the letters BO, (in that order), if letters can be repeated.

(β) that start or end with the letters BO (in that order), if letters can be repeated?

iii) A total of 1232 students have taken a course in Spanish, 879 have taken a course in French, and 114 have taken a course in Russian. Further 103 have taken courses in both Spanish and French, 23 have taken courses in both Spanish and Russian and 14 have taken courses in both French and Russian. If 2092 students have taken at least one of Spanish, French and Russian, how many students have taken a course in all three languages?

Total No. of Questions : 5] **[Total No. of Pages : 4**

P879

[3635] - 103

M.Sc. Tech. (Part - I)

MATHEMATICS

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 103 : Discrete Mathematical Structures - I

(Old Course) (Semester - I)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any EIGHT of the following: **[16]**

a) Symbolize the expression : "Everyone in your class is friendly".

b) Show that $(p \wedge q) \rightarrow (p \vee q)$ is a tautology.

c) If L is a lattice and $a, b, c \in$ L show that $a \wedge (b \wedge c) = (a \wedge b) \wedge c$.

d) Show that every finite semigroup has an idempotent.

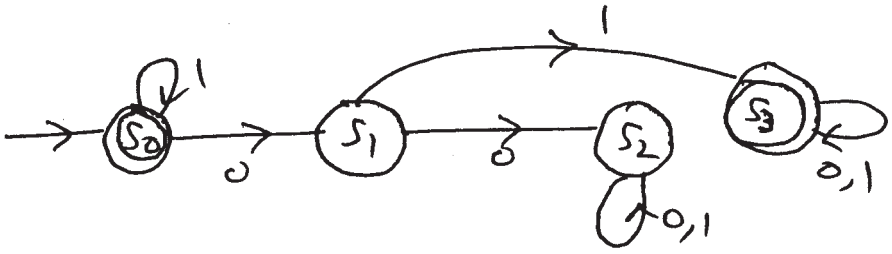
e) On the set N of natural numbers, define the binary operation $*$ by $a * b$ = min $\{a, b\}$ for all $a, b \in$ N. Show that (N, $*$) is a monoid.

f) Prove that in a distributive lattice, every element has at most one complement.

g) Find the sum-of-products expansion for the function

$$F(x, y) = x\bar{y} + \bar{x}y + \bar{x}\bar{y}.$$

h) Find the language recognized by the following DFA:



i) Show that every atom of a lattice is join - irreducible.

j) Give the converse and inverse of the statement. “The policeman carries a stick whenever he is on duty”.

P.T.O.

Q2) a) Attempt any ONE of the following: **[6]**

i) Denote the 'exclusive - or' by $\veebar$. Define $p \veebar q$ as 'p or q but not both'. Write out a truth table for $p \veebar q$.

Show that:

(α) $p \veebar (q \veebar r) \equiv (p \veebar q) \veebar r$

(β) $p \veebar q \equiv (p \vee q) \wedge [-(p \wedge q)]$.

ii) Give an indirect proof to show the validity of the following argument: "If it rains, then I carry an umbrella. If it shines, then I do not need a sweater. Either it rains or it shines. I do need a sweater. Hence I carry an umbrella". (Use $p, q, r, s \ldots$ to symbolize the statements).

b) Attempt any TWO of the following: **[10]**

i) If the universe of discourse is the set of real numbers, translate into English the following:

(α) $\forall x \ \forall y ((x > 0) \wedge (y < 0) \rightarrow (xy < 0))$

(β) $\forall x \ \forall y \ \exists z \ (xy = z)$.

ii) Give an indirect proof of the statement:

"If $5n + 2$ is odd, then n is an odd integer".

iii) Express each of the following statements using quantifiers. Form the negation of each statement and express it in simple English:

(α) All lions are lazy.

(β) Some tigers do not drink tea.

Q3) a) Attempt any ONE of the following: **[6]**

i) Let f be a homomorphism from a semigroup $(S, *)$ to a semigroup $(T, *')$. If S' is a subsemigroup of $(S, *)$, show that

$$f(S') = \{t \in T / t = f(s) \text{ for some } s \in S'\}$$

is a subsemigroup of T.

ii) Let M be a monoid. Show that the intersection of two sub-monoids of M is a sub-monoid of M. Is the union of two sub-monoids of M a sub-monoid of M?

b) Attempt any TWO of the following: **[10]**

i) Let S = {1, 2, 3}. Construct the multiplication table for the semigroup (P(S), U) in usual notation.

ii) On the semigroup (Z, +) define a relation R by *a* R *b* iff *a* and *b* are both even or *a* and *b* are both odd. Determine whether R is a congruence relation on (Z, +).

iii) Show that the set G_S of all invertible elements in a monoid (S, $*$) is a group with respect to $*$.

Q4) a) Attempt any ONE of the following: **[6]**

i) Show that for all *a*, *b*, *c* in a lattice L,

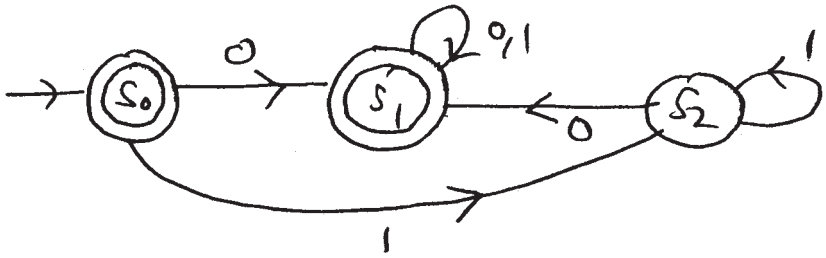
$$(a \wedge b) \vee (b \wedge c) \vee (c \wedge a) \leq (a \vee b) \wedge (b \vee c) \wedge (c \vee a).$$

ii) If L is a complete lattice, and θ:L $\rightarrow$ L is a homomorphism, prove that there exists $a \in$ L such that $\theta(a) = a$.

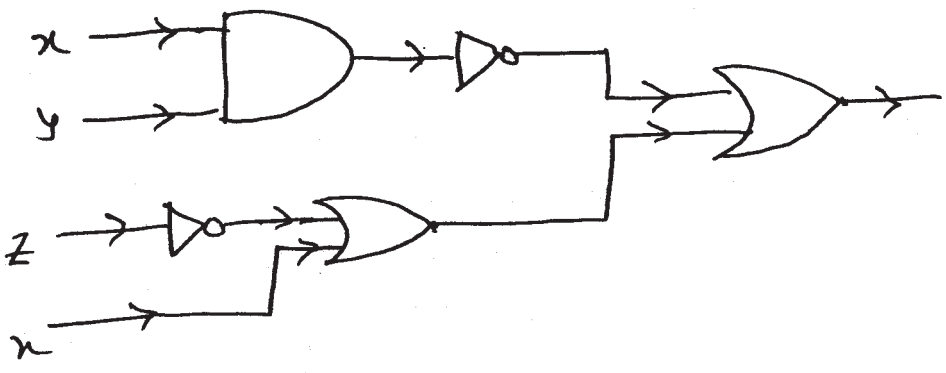
b) Attempt any TWO of the following: **[10]**

i) Give an example of a modular lattice which is not distributive. Is every distributive lattice modular? Justify.

ii) Find the language recognized by the following DFA. Construct the state table:-



iii) Find the output of the circuit.



Q5) Attempt any FOUR of the following: **[16]**

a) Define a Boolean algebra. Show that for all x, y in a Boolean algebra

$$\overline{x \vee y} = \bar{x} \wedge \bar{y}.$$

b) Give an indirect proof of the validity of the argument

$$p \rightarrow r, \sim q \rightarrow p, \sim r \vdash q.$$

c) Prove that any two Boolean algebras having n elements each, are isomorphic.

d) Construct the state diagram for the NDFA with state table as shown below, with final states S_2 and S_3 and with S_0 as START state.

STATE	INPUT	
↓	0	1
S_0	S_0, S_1	S_3
S_1	S_0	S_1, S_3
S_2		S_0, S_2
S_3	S_0, S_1, S_2	S_1

e) Let (S, $*$) and $(S', *')$ be monoids with identity elements e and e'. Let $\phi : S \rightarrow S'$ be an epimorphism. Show that $\phi(e) = e'$.

Total No. of Questions : 5] **[Total No. of Pages : 4**

P880

[3635] - 104

M.Sc. Tech.

COMPUTER

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 104 : C Programming (New)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***All questions carry equal marks.***
3) ***Neat diagrams must be drawn whenever necessary.***

Q1) Attempt any 8 : **[8 x 2 = 16]**

a) State output of the following program?

```
main ( )
{
printf ("%d %d %d", sizeof (3.14f), sizeof (3.14), sizeof (3.14 1));
}
```

b) What is recursion?

c) What is difference between a null pointer & null string.

d) What are different operations to handle files.

e) What is the purpose of the library function f flush ( )?

f) What would be the output of the following program.

```
main ( )
{    int i = 4;
     switch (i)
     {
          default :
               printf ("\n a mouse is an elephant built by the
               Japanese");
     Case 1 :
          Printf ("\n Breeding rabbits is hare raising experience")
          break;
```

P.T.O.

```
        Case 2 :
            printf ("\n Friction is a drag");
            break;
        Case 3 :
            printf ("\n if practice makes man perfect, then nobody's
            perfect");
            }
        }
```

g) What are advantages of command line argument.

h) Explain : Global variable.

i) State True / False.

i) In C all functions except main ( ) can be called recursively.

ii) In a function two return statements should never occur successively.

j) Distinction between macro & function.

Q2) Attempt any 2 : **[2 x 8 = 16]**

a) Write a 'C' program which define a structure to represent the information of student in terms of rollno, name, city & the marks of 3 subjects. program reads the information of 100 students and perform the following operations.

i) Display a list of students residing in the city Pune.

ii) Display the marklist of each student in terms of rollno, name, marks, result & percentage marks.

b) Define a function fstrrev ( ) which receives the address of a string reverse the sequence of characters stored in the string use this function appropriately from the main ( ) program.

c) Write 'C' program reads two matrices of the order entered by the user, adds them & display the resultant matrix. [If order is not same then give appropriate message].

Q3) Attempt any 4 : **[4 x 4 = 16]**

a) What is the meaning of "call by reference"? How it is supported in C. Explain with example.

b) What are different file opening modes in C? Explain briefly.

c) What are different types of sorting array elements? Explain any two with example.

d) What is difference between structure & union.

e) What is difference between compiler & interpreter.

Q4) a) Answer the following questions: **[3 x 2 = 6]**

i) Explain C program development life cycle.

ii) What would be the output of the following program

```
# define PRINT (int) printf ("int = %d", int)
main ( )
{   int x = 2, y = 3, z = 4;
    PRINT (x);
    PRINT (y);
    PRINT (z);
}
```

iii) State output of the program.

```
main ( )
{
    struct emp
    {
        char * n;
        int   age;
    };
    struct emp el = {"Dravid", 23};
    struct emp e2 = el;
    strupr (e2.n)
    printf ("\n%s", el.n);
}
```

b) Answer any 2 : **[5 x 2 = 10]**

i) Explain following:

- Assembly language.

- High level language.

ii) Explain different operators types. What is associativity rule.

iii) Explain concept of pointer to function with suitable example.

Q5) a) Attempt any 2 : **[2 x 4 = 8]**

i) A file contains the information of a few employees in the structured format of name, age & bs. Write 'C' prog. which reads the information from the file & display it on the user screen.

ii) Define a function fstrset ( ) which receive a string & a character replaces each existing character of the string with the newly entered character. Use this function appropriately from main ( ) program & display the modified string.

iii) Write a 'C' program which reads a 6 x 4 matrix from the user & find the maximum element from the matrix along with its row, column position in the matrix.

b) Attempt any 2 : **[2 x 4 = 8]**

i) Explain concept of nested structures with suitable example.

ii) Explain standard library string function:

– Strlen ( )

– Strcpy ( )

iii) What is Dynamic memory allocation.

.

Total No. of Questions : 5] **[Total No. of Pages : 4**

P880

[3635] - 104

M.Sc. Tech.

COMPUTER

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 104 : Programming in C with ANSI Features - I

(Old Course)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***All questions carry equal marks.***
3) ***Figures to the right indicate full marks.***

Q1) Attempt any eight of the following: **[16]**

a) What formal parameters are used with scanf ( ).

b) Explain different ways to terminate the loop execution.

c) What is the purpose of extern key word.

d) Which of the following are invalid identifiers? Why?

i) 124.56 ii) Float iii) Name.

e) Give the O/P of the following,

If i = –3, j = 2, k = 0.

x = + + i & & + + j || + + k

f) Explain the use of cast operator.

g) State the value of the following expressions. The initial values are

x = 1, y = 2, z = 4

i) – – z + x + + ii) z – – + + + x.

h) Compare operators > > & < <.

i) Give the usage & syntax of the go to statement.

j) Differentiate between structure & union.

Q2) Attempt any two of the following: **[16]**

a) Write a 'C' program to check whether a given number is a perfect number or no.

P.T.O.

b) Write a 'C' program to reverse a given string using pointers & function.

c) Write a program to calculate the average mean & variance of n numbers using the foll. formulae.

Mean $\overline{X} = \frac{\sum_{i=1}^{n} X_i}{n}$

Variance $= \frac{\sum_{i=1}^{n} X_i}{n} - \overline{X}^2$

Q3) Attempt any four of the following: **[16]**

a) Explain the switch case statement with the help of example.

b) What is the difference between getch ( ) & getche ( )?

c) Explain the concept of unions with the help of an example.

d) Explain call by value and call by reference.

e) What do the following terms mean?

a) Scope b) Storage class.

Q4) Attempt any eight of the following: **[16]**

a) Write two differences between auto and static variables.

b) Trace the O/P of following code

```
# include <stdio. h>
main ( )
{
    int i = 4;
    switch (i)
    {
        default : printf ("A");
        case 1 : printf ("B");
        case 4 : printf ("C");
    }
}
```

c) Trace the O/P of following code.

```
# include <stdio.h>
main ( )
{
    int x = 12, y;
    y = x - - ;
    y = - -  x;
    printf ("%d  %d"; x, y);
}
```

d) Distinguish between strcmp ( ) & strncmp ( ) functions.

e) Given i = 0, j = 2 & k = 3 find the value of x.

```
x = i + + ? j - - : k - - ;
```

f) What is the use of typedef?

g) Find the O/P of the following:

```
# include <stdio.h>
main ( )
{
    char c = 'z', ch;
    c = c + 'a' - 'A';
    ch = c – 'a' + 'A';
    printf ("%c", ch);
}
```

h) Find the O/P of the following:

```
# include <stdio.h>
main ( )
{
    int x = 5, y = 50, z = (x + y) * 10;
    while (x < = 5)
    x = y | x;
printf ("%d", x);
}
```

i) If n = 1000 find the value of n < < z.

Q5) a) Attempt any two of the following: **[8]**

i) Explain bitwise operators in C.

ii) Explain the break & continue statement.

iii) Write note on dynamic memory allocation.

b) Attempt any two of the following: **[8]**

i) Write a function to reverse the given string without using the built - in function.

ii) Write a 'C' program to accept a matrix & find the largest & smallest number from the matrix.

iii) Write a function that accepts a string & count the occurrence of given character in the string.

Total No. of Questions : 5] **[Total No. of Pages : 2**

P881

[3635] - 105

M.Sc. Tech. Computer

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 105 : Elements of Information Technology

(New Course)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any eight of the following: **[8 x 2 = 16]**

a) Distinguish between electronic calculator and computer.

b) State the different type of number systems.

c) State the features of binary number system.

d) Compare binary number system with BCD code.

e) State the types of secondary memory.

f) Distinguish between RAM and ROM.

g) What is a compiler? Give one example.

h) State the function of CPU.

i) State the components of LAN.

j) What is a World Wide Web (WWW)?

Q2) Attempt any four of the following: **[4 x 4 = 16]**

a) State the advantages of Harvad model over the Von Neumann model of computer.

b) Explain with suitable example the method of conversion of decimal number into binary number.

c) State the types of computer. Give the advantages of personal computer.

d) Explain the performance parameters of digital computer.

e) Convert the decimal number 19 into Hexadecimal, Octal and BCD.

P.T.O.

Q3) Attempt any four of the following: **[4 x 4 = 16]**

a) Write a short note on ASCII code.

b) What is primary memory? Explain any one type in detail.

c) Explain with a neat diagram the operating principle of hard disk drive.

d) Give comparison between magnetic and optical storage devices.

e) Explain with a neat diagram the working of any one type of scanner.

Q4) Attempt any four of the following: **[4 x 4 = 16]**

a) Explain with diagram the working principle of Optomechanical mouse.

b) Discuss with necessary diagram the working of LASER printer.

c) Give comparison between the impact and non-impact printer.

d) Explain with neat diagram the operation of VDU monitor.

e) Distinguish between CD and DVD.

Q5) Attempt any two of the following: **[2 x 8 = 16]**

a) State the types of network topology. Explain with flow chart the CSMA / CD method of data communication.

b) Explain with a neat optical ray diagram the operation of CD ROM drive.

c) What is WINDOWS? What are the operations that can be performed on a window?

Total No. of Questions : 5] **[Total No. of Pages : 2**

P881

[3635] - 105

M.Sc. Tech. Computer

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 105 : Computer Architecture

(Old Course)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Use of log table / calculator is allowed.***

Q1) Attempt any eight of the following: **[8 x 2 = 16]**

a) State the function of stack memory.

b) State one application of logical XOR gate.

c) What do you mean by Synchronization?

d) State the difference between BCD and binary.

e) State the De-Morgan's first theorem.

f) State the use of stack pointer.

g) State the function of instruction pointer.

h) Draw a logic symbol of AND gate and give its truth table.

i) State the purpose of 'Address bus' in microprocessor.

j) State the different type of derived logic gates.

Q2) Attempt any four of the following: **[4 x 4 = 16]**

a) State the types of output devices. Explain the operating principle of VDU monitor.

b) Distinguish between Impact and Non-impact printers.

c) Explain the working principle of flat bed scanner.

d) Explain with necessary sequence of diagrams the working of LASER printer.

e) Write a short note on electromechanical mouse.

P.T.O.

Q3) Attempt any <u>four</u> of the following: **[4 x 4 = 16]**

a) Explain the logic diagram of full adder and write its truth table.

b) Describe the working of R - S flip - flop with necessary logic diagram.

c) Draw logic diagram for the expression:

$$Y = (A \cdot B) + (C \cdot D)$$

d) Discuss the massage passing model of parallel programming.

e) Construct the logical XOR gate using basic gates.

Q4) Attempt any <u>four</u> of the following: **[4 x 4 = 16]**

a) Explain with neat diagram the concept of shared and distributed memory.

b) Explain with neat diagram the Von-Neumann model of computer system.

c) Write a note on Load balancing in parallel programming.

d) Explain with necessary diagram 'SIMD' and 'MIMD' type of parallel processors.

e) Draw a logic diagram for the logic expression.

$$Y = \left(\overline{A + B}\right) \cdot \left(\overline{A} + \overline{B}\right)$$

Q5) Attempt any <u>four</u> of the following: **[4 x 4 = 16]**

a) Distinguish between dynamic and static memory.

b) Explain the features of Intel 80386 microprocessor.

c) Discuss with neat ray diagram the operation of CD - ROM drive.

d) Explain with suitable example the instruction pipelining.

e) Explain with necessary diagram the architecture of any one type of microprocessor.

Total No. of Questions : 5] **[Total No. of Pages : 4**

P882

[3635] - 201

M.Sc. (Tech.)

MATHEMATICS

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 201 : Real and Complex Analysis

(Old & New Course) (Semester - II)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any EIGHT of the following: **[16]**

a) Let X = {1, 2, 3}. Let $\mathcal{A} = \mathcal{P}(X)$. Show that $\mathcal{A}$ is an algebra.

b) If E is a measurable set of reals, prove that its complement, E^C, is also a measurable set.

c) If f, g are real valued functions on [0, 1] such that $f(x) = x^4$, $0 \le x \le 1$ and $g(x) = f(x)$ almost every where on [0, 1], find $\int_0^1 g$.

d) Let f, g be bounded measurable functions defined on a set E of finite measure. Prove that $\int_E f + g = \int_E f + \int_E g$.

e) Let f be a real valued measurable function on the measurable set $E \subseteq R$. Let $k \in R$. Prove that kf is a measurable function on E.

f) Discuss continuity of the function

$$f(z) = \begin{cases} \dfrac{(\mathrm{Re}\, z)(\mathrm{Im}\, z)}{|z|^2} & , \quad z \neq 0 \\ 0 & , \quad z = 0 \end{cases}$$

at $z = 0$.

g) Let $f(z)$ be analytic in a domain $D \subseteq C$, such that the imaginary part of $f(z)$ is constant. Show that $f(z)$ is a constant function on D.

P.T.O.

h) Show that $\int_C z^n dz = 0$, where n is an integer, $n \neq -1$, and C is the unit circle $|z| = 1$. Evaluate $\int_C \frac{\sin z}{z(z-2)} dz$ where C is the circle $|z| = 1$.

i) Obtain the residue of $f(z) = \frac{3z^2 + 1}{(z-1)(z-2)}$ at its pole $z = 2$.

Q2) a) Attempt any ONE of the following: **[6]**

i) Let $\{E_n\}$ be a countable collection of sets in R. Prove that

$$m^*\left(\bigcup_{n=1}^{\infty} E_n\right) \leq \sum_{n=1}^{\infty} m^* E_n.$$

ii) Let $A \subseteq R$. Show that for any $\in > 0$ there exists an open set O such that $A \subseteq O$ and $m^* O < m^* A + \in$.

b) Attempt any TWO of the following: **[10]**

i) Let f, g be measurable functions on the measurable set $E \subseteq R$. Show that the set $E(f > g) = \{x \in E / f(x) > g(x)\}$ is a measurable set.

ii) Let E be a measurable set in R. Let $x \in R$. Show that the set $E + x$ is measurable and that $m(E + x) = mE$.

iii) Let f be an extended real - valued function whose domain is measurable. Show that for any $\alpha \in R$, the set $\{x / f(x) > \alpha\}$ is measurable iff the set $\{x / f(x) \geq \alpha\}$ is measurable.

Q3) a) Attempt any ONE of the following: **[6]**

i) Show that a countable union of measurable sets is measurable.

ii) For any closed curve C and $a \notin C$, show that the winding number $n(C; a)$ is an integer.

b) Attempt any TWO of the following: **[10]**

i) Let $f(z) = \frac{x^3 - y^3}{x^2 + y^2} + i\left(\frac{x^3 + y^3}{x^2 + y^2}\right)$, $(x, y) \neq (0, 0)$,

$= 0$, $(x, y) = (0, 0)$.

Show that the Cauchy Riemann equations are satisfied by f at the origin (0, 0), yet that f is not differentiable at (0, 0).

ii) If $f(z) = u(x, y) + iv(x, y)$ is analytic in a domain D, show that $u(x, y)$ and $v(x, y)$ are harmonic functions on D.

iii) Let $f : C \to C$ be a continuous function at $z_0 \in C$. If $g : C \to C$ is continuous at the point $f(z_0) \in C$, show that the composite function $gof : C \to C$ is continuous at $z_0 \in C$.

Q4) a) Attempt any ONE of the following: **[6]**

i) Let f be continuous in an open set D and let $\int_C f(z)\,dz = 0$ for each piece - wise differentiable closed curve C in D - show that f is analytic in D.

ii) Let f be analytic in the open disc $\Delta(z_0; R)$ and $|f(z)| \le M$ for $z \in \partial\Delta$ $(z_0; R)$. Let $0 < r < R$. Show that for each $k \in N$ and for every $a \in \Delta(z_0; r)$, $|f^{(k)}(a)| \le \frac{Mk!}{r^k}$.

b) Attempt any TWO of the following: **[10]**

i) Show that a bounded entire function is a constant.

ii) Obtain a Laurent series expansion of $f(z) = \frac{1}{(z-3)(z-4)}$ valid for $3 < |z| < 4$.

iii) Find the value of $\int \frac{e^z dz}{(z+1)^2}$ where C is the circle $|z-1| = 3$.

Q5) Attempt any FOUR of the following: **[16]**

a) Show that a bilinear transformation is a composition of translations, dilation and an inversion, not necessarily in that order.

b) Obtain $\int_C e^z\,dz$ where C is the circle $|z| = 1$. Hence or otherwise, show that $\int_0^{2\pi} e^{\cos\theta} \cos(\theta + \sin\theta)\,d\theta = 0$.

c) Use the residue theorem to evaluate $\int_0^{2\pi} \frac{d\theta}{5 + 4\cos\theta}$.

d) Obtain a Maclaurin series expansion for $f(z) = \sin z$.

e) Show that the inverse of a Möbius transformation is also a Möbius transformation.

Total No. of Questions : 5] **[Total No. of Pages : 3**

P883

[3635] - 202

M.Sc. Tech. (IMCA)

MATHEMATICS

MIM - 202 : Algebra - II

(Old & New)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any eight of the following: **[16]**

a) Give an example of algebraic field, with justification.

b) Construct a field with 4 elements.

c) Show that $x^3 + x^2 + 1$ is irreducible over Z_2.

d) Show that $\sqrt[3]{2} + 5$ is algebraic over the field of rationals.

e) Define Galois group.

f) Show that the set $B = \{2, 1 + x, 1 + x^2\}$ is a basis of $P_2(x)$.

g) Find the characteristic polynomial of the matrix

$$A = \begin{bmatrix} 3 & 1 & -1 \\ 2 & 2 & -1 \\ 2 & 2 & 0 \end{bmatrix}.$$

h) Find the matrix representation of the linear map $T : R^3 \rightarrow R^3$ with respect to the standard basis, where

$T(x, y, z) = (x + 3y \;\; 2x - 4z, 2x + 3y + 4z)$.

i) If A is a 3 x 4 matrix and nullity of A is 2, then find rank of A.

j) If $W = \{(x, y) \in R^2 / x \geq 0\}$, then show that W is not a subspace of R^2, by giving reason.

Q2) a) Attempt any one of the following: **[6]**

i) If A is a square matrix, then prove that A satisfies its characteristic polynomial.

ii) Show that intersection of two subspaces is again a subspace. What about the union? Justify.

P.T.O.

b) Attempt any two of the following: **[10]**

i) If $T : R^3 \to R^3$ is a linear transformation such that $T(1, 0, 0) = (1, 0 -1)$, $T(1, 1, 0) = (1, 2, 3)$ and $T(1, 0, 1) = (0, 0, 1)$. Find the formula for T.

ii) In an inner product space V, prove that $\|\|\vec{u}\| - \|\vec{v}\|\| \leq \|\vec{u} - \vec{v}\|$.

iii) Consider the vectors $\vec{v}_1 = (3, 0, 4)$, $\vec{v}_2 = (-1, 0, 7)$, $\vec{v}_3 = (2, 9, 11)$ in R^3 equipped with standard inner product. Apply gram Schmidt process to obtain an orthonormal set.

Q3) a) Attempt any one of the following: **[6]**

i) State and prove rank nullity theorem for linear transformations.

ii) Prove that an *n* - square matrix is diagonalizable if and only if it has *n* linearly independent eigen vectors.

b) Attempt any two of the following: **[10]**

i) Find the basis and dimension of the eigenspace corresponding to the greatest eigenvalue of A,

$$\text{where } A = \begin{bmatrix} 5 & -6 & -6 \\ -1 & 4 & 2 \\ 3 & -6 & -4 \end{bmatrix}.$$

ii) Let $U = \{(x, y, z) \in R^3 / 2x + 3y + z = 0\}$. Show that U is a subspace of R^3.

iii) Find the orthogonal projection of (6, 3, 4) on the subspace W that is spanned by (3, 1, 1).

Q4) a) Attempt any one of the following: **[6]**

i) Show that every abelian group G is a module over the ring of integers.

ii) If $F \subset E \subset K$ and $[E : F] = m$ and $[K : E] = n$, then prove that $[K : F] = mn$.

b) Attempt any two of the following: **[10]**

i) Show that every finite extension is algebraic.

ii) Find the degree of extension of $Q(\alpha)$ over Q, where $\alpha = \sqrt{5} + \sqrt{2}$.

iii) State only the Fundamental theorem of Galois theory.

Q5) a) Attempt any <u>one</u> of the following: **[6]**

i) If $f(x) \in F[x]$, then prove that there is a finite extension E of F in which $f(x)$ has a root.

ii) Let K be a finite extension of degree n of a finite field F of p^r elements. Then prove that G(K/F) is cyclic of order n.

b) Attempt any <u>two</u> of the following: **[10]**

i) Determine the splitting field of $x^3 - 2$ over Q, what is the degree of extension?

ii) Prove that a finite field of p^n elements exists for every prime p and $n \in N$.

iii) If F is a finite field, then show that $F^* = F\setminus\{0\}$ is a cyclic group for multiplication.

Total No. of Questions : 5] **[Total No. of Pages : 3**

P1047

[3635]-501
M.Sc. Tech.
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 501 : Compiler Techniques

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates:

1) ***All questions are compulsory and carry equal marks.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any EIGHT of the following : **[16]**

a) What phases of compiler form the front end of a compiler? Why?

b) Explain the terms token, pattern and lexene with an example.

c) What are regular definitions?

d) What is an ambiguous grammar? Illustrate with an example.

e) Give the rules for deriving First sets.

f) What is an operator grammar? Is the grammar $E \rightarrow EOE/<id>$, $O \rightarrow +/*$ an operator grammar?

g) What are the four possible actions in LR parsers?

h) Explain synthesized attribute with an example.

i) The assignment such as $x = f(a, b)$ cannot be considered as a dead code even if x is never used. Why?

j) What is ARB? What is it used for?

Q2) a) Attempt any ONE of the following : **[6]**

i) Write recursive descent parser for the grammar $S \rightarrow abA/aaB$
$A \rightarrow baA/bB$
$B \rightarrow bB/b$

ii) Construct operator precedence table after computing leading and trailing sets for the grammar $S \rightarrow L = R/R$,
$R \rightarrow L$,
$L \rightarrow *R/id$

P.T.O.

b) Attempt any TWO of the following : **[10]**

i) Show with an example how transition diagram can be implemented by writing code for each state and transition in the diagram.

ii) Explain the use of input buffering in lexical analysis. Discuss the use of sentinels in input buffering.

iii) State different phases of a compiler and illustrate how error handling is evoked by every phase.

Q3) a) Attempt any ONE of the following : **[6]**

i) Check if the following grammar is simple LR by constructing parsing table

$S \rightarrow E + E/d$

$E \rightarrow E - T/T$

$T \rightarrow T\ *d/d$

ii) What is printed by the following program segment assuming A) Call by value B) Call by value-result and C) Call by reference? Justify.

```
Procedure proc (X, Y, Z)
begin
    Y = Y + 1;
    Z = Z + X;
end proc // end of procedure
begin // main program begins
A = 4;
B = 5;
Proc (A + B, A, A); // procedure call
Print A;
end
```

b) Attempt any TWO of the following : **[10]**

i) Explain the contents of an activation record.

ii) Explain the process of boot strapping a compiler.

iii) What is parsing? What characteristics top-down parsing? What problems are associated with top-down parsing?

Q4) Attempt any FOUR of the following : **[16]**

a) Discuss the components and working of a predictive parser.

b) What are S-attributed definitions? What are L-attributed definitions? Every S-attributed definition is L-attributed. Justify.

c) Explain triples with an example.

d) What is a syntax tree? Give the syntax directed definitions for creating syntax trees.

e) Discuss the issues to be considered while compiling function calls.

f) Explain how the higher order control structures if and while are converted into intermediate code containing goto's.

Q5) Attempt any FOUR of the following : **[16]**

a) What is an activation? Explain activation tree with an example.

b) What is directed acyclic graph for expressions? Illustrate construction of DAG for the expression

a + b*(c – d) + (c – d)*a.

c) Explain the use of static and dynamic pointer with an example.

d) What is a symbol table? Discuss the use of list data structure in implementing symbol table.

e) Explain strength reduction and frequency reduction.

f) What is a basic block? Explain with example value numbering technique for determining equivalence of basic blocks.

✷✷✷

Total No. of Questions : 5] **[Total No. of Pages : 2**

P1048

[3635]-502
M.Sc. Tech. (Semester - V)
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 502 : Software Engineering

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any eight of the following : **[16]**

a) Give any two characteristics of a system.
b) What do you mean by Software Engineering?
c) State any two objective of a feasibility study.
d) Define : Coupling.
e) Define : 4GL approach.
f) How are test-case data generated?
g) State the symbols used to draw E-R diagram.
h) What do you mean by system maintenance?
i) Define : Abstraction.
j) Give any two functions of a system analyst.

Q2) Attempt any four of the following : **[16]**

a) Explain: Fact Finding Techniques.
b) Explain the qualities of software.
c) Explain SDLC with waterfall model.
d) Compare structured interview with unstructured interview.
e) Explain the types of cohesion.

Q3) Attempt any two of the following : **[16]**

a) Draw a Decision Tree for the following case study.

ABC company Ltd decides to give Diwali bonus to all employees for which the management has decided three categories of employees namely Administrative staff, office staff, workers and considered the following rules.

P.T.O.

i) If the employee is permanent and in Administrative category the bonus amount is 3 months salary.
ii) If the employee is permanent and in office the bonus amount is 2 months salary.
iii) If the employee is permanent and in worker category the bonus amount is one month salary.

If the employees are temporary then half of the amount is given to them as per the permanent employee's bonus amount.

b) Explain the principles of testing methodology in detail.

c) Consider a system for swimming tank system. Applicants fill the admission form containing details like address, date-of -birth, age, father's/guardian's name and also submit two photographs, medical certificate, birth certificates and fees. Then swimming tank management issues I-card to the applicant.

Construct the following for the above case study.

i) Context level Data flow diagram.
ii) First level Data flow diagram.

Q4) Attempt <u>any two</u> of the following : **[16]**

a) Compare the features of white box testing and black box testing.

b) Explain the usage of metrics related to software maintenance.

c) Explain the factors used to calculate the cost of quality in a software system.

Q5) Attempt <u>any four</u> of the following : **[16]**

a) Write a note on : Deployment level design element.

b) Explain : Prototyping model in detail.

c) Write a note on the characteristics of a good quality design.

d) Explain any four characteristics of component based approach in software model.

e) Explain "Structure chart" with an example.

✷✷✷

Total No. of Questions : 5] **[Total No. of Pages : 3**

P1049

[3635]-503
M.Sc. Tech.
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 503 : Computer Networks

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any eight : **[16]**

a) "Performance of slotted ALOHA is better than pure ALOHA". Justify.

b) What is the use of a token?

c) Define Defacto and Dejure standards.

d) List any two application layer protocols that use TCP.

e) Explain any two service primitives in connection oriented service.

f) Give the basic idea behind Telnet.

g) State advantage of STP over UTP.

h) Find the bit rate for a noiseless channel whose band width is 32 KHz and passes a signal having 16 levels.

i) List the fields in the IP datagram used for fragmentation.

j) List out main functions of network layer.

Q2) A. Attempt any one : **[6]**

a) What is a bridge? Explain the working of a transparent bridge.

b) What is an internetwork? Explain how networks can differ from one another.

B. Attempt any two : **[10]**

a) What is the class of IP address 168·25·56·121? Find the maximum number of subnets in class B using the address mask 255·255·192·0. What is the default mask for class B networks?

P.T.O.

b) What is the need for controlled access? Explain any one technique for it.

c) What are the factors that can affect a signal? State advantages of digital transmission.

Q3) A. Attempt <u>any one</u> : **[6]**

a) What are the different ethernet types? Draw the frame format for an ethernet frame and explain all the fields.

b) What is routing? Explain the characteristics of routing algorithms. Give examples of adaptive and nonadaptive routing algorithms.

B. Attempt <u>any two</u> : **[10]**

a) Explain in short CSMA/CD protocol. How is it different than CSMA/CA.

b) Encode 10110001 using Manchester encoding, differential Manchester encoding and AMI.

c) Explain the concept of port and socket address with an example. How are port addresses classified?

Q4) A. Attempt <u>any one</u> : **[6]**

a) What is channelization? Explain in brief the concept behind CDMA.

b) Write a short note on cellular technology.

B. Attempt <u>any two</u> : **[10]**

a) What is modulation? Why is it required? Explain frequency modulation.

b) Write a note on different types of services provided by ISO-OSI model.

c) Calculate data rate for a noisy channel if S/N ratio is 4095, channel bandwidth is 16 kHz and 32 levels of signalling is used. Also express the signal to noise ratio in decibels.

Q5) Attempt <u>any four</u> : **[16]**

a) What are guided and unguided transmission medium? Explain any one guided transmission medium in brief.

b) If the header length of IPV4 datagram is 32 bytes, what will be the value of HLEN field? What can be the maximum header size? Give the use of time to live field and options field in IPV4.

c) Write a short note on FTP.

d) State the goals and applications of computer networks.

e) Explain in brief the different multiplexing techniques.

f) Write a short note on the various issues to be dealt while adding a new layer to network model.

Total No. of Questions : 5] **[Total No. of Pages : 3**

P1050

[3635]-504
M.Sc. Tech.
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 504 : Computer Graphics

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any EIGHT of the following : **[16]**

a) Differentiate movable and nonmovable Joystick.

b) Explain the use of computer graphics in entertainment.

c) Why line clipping algorithm can not be used for polygon clipping by considering polygons as collections of lines?

d) What is 4-connected method of considering neighbouring points? Why it may not fill polygons correctly?

e) What is the fraction of the total refresh time per frame spent in retrace of the electron beam for a non-interlaced raster system with a resolution of 1280 by 1024, a refresh rate of 60 Hz, a horizontal retrace time of 5 microseconds and a vertical retrace time of 500 microseconds?

f) Define Hermite splines.

g) Define zero-order and first order parametric continuity.

h) Explain region codes used in Cohen-sutherland algorithm.

i) Explain the need for homogeneous coordinates.

j) Find the concatenated transformation matrix for translation in X-direction by 4 units and scaling in Y-direction by 2 units.

Q2) a) Attempt any ONE of the following : **[6]**

i) Discuss the two methods of producing color display in a cathode ray tube.

ii) Explain DDA algorithm for line drawing. Why is not efficient?

P.T.O.

b) Attempt any TWO of the following : **[10]**

i) Write a short note on tablet or digitizer.

ii) Explain edge fill algorithm. Explain how the number of pixels can be reduced by introducing a fence.

iii) Explain midpoint-subdivision line-clipping algorithm.

Q3) a) Attempt any ONE of the following : **[6]**

i) Consider a triangle with vertices A (5, 3), B (3, 8) and C (9, 6). Find the transformation for magnifying the triangle twice its size by keeping point A (5, 3) as fixed. Find the new vertices of the triangle.

ii) Illustrate the general Bresenhan's line drawing algorithm for generating line between A (–2, 1) and (4, 4).

b) Attempt any TWO of the following : **[10]**

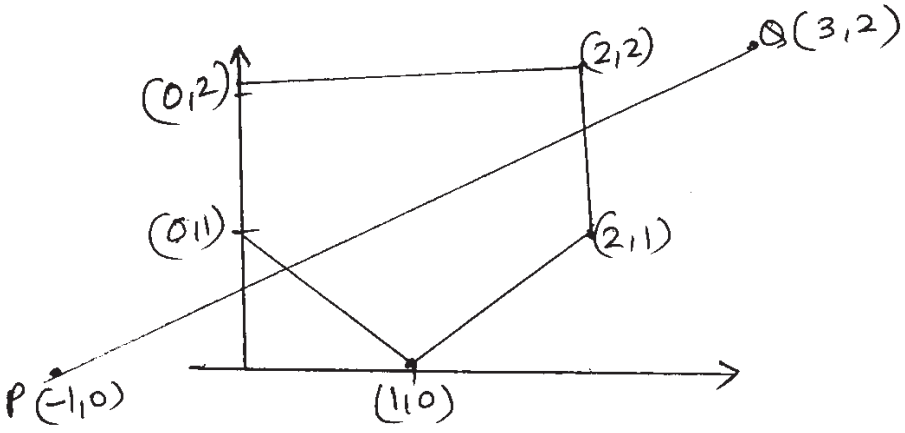
i) Explain reflection transformation and give the algorithm for reflection about any arbitrary line.

ii) Write a note on vanishing points.

iii) What is a shear transformation. Explain basic shear transformations.

Q4) a) Attempt any ONE of the following : **[6]**

i) A five sided polygonal clipping window is shown below. Illustrate the complete working of the Cyrus-Beck algorithm for the line P (–1, 0) and Q (3, 2).



ii) Consider the line segment A [1, 2] and B [3, 6]. Give the transformation matrix for

A) Rotating AB by an angle 90° counterclockwise about its midpoint.

B) Rotating AB by an angle 90° clockwise about the point A.

b) Attempt any TWO of the following : **[10]**

i) Explain cabinet and cavalier projection illustrating with diagrams.

ii) Discuss the area subdivision algorithm for hidden surfaces.

iii) What are the two types of parallel projections? Explain different elevations.

Q5) a) Attempt any ONE of the following : **[6]**

i) What are B-spline curves? Discuss the properties of B-spline curves.

ii) Consider the line segment parallel to Z-axis with end points (3, 2.4) and (3, 2.8). Perform a perspective projection onto XY plane from a center of projection Z = – 2. Find the point of intersection of projected line with Z-axis.

b) Attempt any TWO of the following : **[10]**

i) If $B_0 = [2, 3]$, $B_1 = [3, 5]$, $B_2 = [5, 6]$, $B_3 = [6, 3]$ are the vertices of Bezier polygon, then determine the point P(.5) on Bezier curve.

ii) Obtain Blending function for open uniform B-spline with d = 3 and n = 4.

iii) Write a note on quadric and spline surfaces.

✷✷✷

Total No. of Questions : 5] **[Total No. of Pages : 3**

P885 [3635] - 204

M.Sc. Tech. - I

COMPUTER SCIENCE

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 204 : Database Fundamentals

(New Course)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any eight : **[16]**

a) List any two significant differences between a file-processing system and a DBMS.

b) State the purpose of a 'σ' operator.

c) Define Referential Integrity.

d) What is a super key?

e) Define : Multivalued attributes.

f) Define : Relational data model.

g) What do you mean by 'Data Independence'?

h) What are the data types in SQL?

i) List the different DML statements.

j) Define : Trivial functional dependencies.

Q2) Attempt any four of the following : **[16]**

a) What are the main functions of a database administrator?

b) Explain the concept of aggregation with an example.

c) Discuss various notations used for E-R schema diagram.

d) How does the tuple relational calculus differ from domain calculus?

e) Explain any 4 aggregate function with an example.

Q3) Attempt any four of the following : **[16]**

a) What is a trigger? Explain different events when trigger can be activated.

b) What is data abstraction? Explain the different levels of them.

P.T.O.

c) Consider the following schema

R = (A, B, C)

S = (D, E, F)

Give an equivalent SQL statement for the following :

i) $\pi_{A}(r)$ ii) $\sigma_{B=17}(r)$

iii) r x S iv) $\pi_{A,F}\left(\sigma_{C=D}(r \times S)\right)$.

d) Explain correlated queries with an example.

e) Explain Joins. State the different types of Joins.

Q4) a) Attempt the following : **[10]**

Consider a university database for the scheduling of classrooms for final exams. This database could be modeled as the single entity set exam, with attributes course-name, section-number, room-number, and time. Additional entity sets are as follows :

* Course with attributes name, department and C-number.
* Section with attributes S-number and enrollment and dependent as a weak entity set on course.
* Room with attributes r-number, capacity and building.

Show an E - R diagram that illustrates the above scenario.

b) Attempt any one of the following : **[6]**

i) Write a note on cursors.

ii) What is normalization? Explain BCNF in detail.

Q5) a) Attempt the following : **[10]**

Consider the following schema :

employee (emp-name, street, city)

works (emp-name, company-name, salary)

company (company-name, city)

manages (emp-name, manager-name)

Solve the following queries in SQL :

i) Find all employees in the database who live in the same cities as the company for which they work.

ii) Find the company that has the most employees.

iii) Find all employees who do not work for First Bank corporation.

iv) List all the employees whose salary is more than Rs. 1 lakh.

v) Display manager-wise list of employees.

b) Attempt <u>any one</u> of the following : **[6]**

i) Consider the following schema :

company (name, address, city, sharevalue)

person (person-name, person-city)

comp-person (name, person-name, number-of-share)

1) Write a block which displays the total share value for a given city. (Pass cityname as parameter)

ii) Consider the following relation.

Movie (movie-no., name, release-year)

Actor (Actor-no., name, age)

Movie - Actor (movie-no., Actor-no., rate)

1) Write a block to list all the actors-name who have acted in a movie after the year 2000.

2) Print the details of the movies for a given actor. (Pass Actor-no. as a parameter to the function).

Total No. of Questions : 5] **[Total No. of Pages : 3**

P885 [3635] - 204

M.Sc. Tech. - I

COMPUTER SCIENCE

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 204 : Programming in C with ANSI Features - II

(Old Course)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any eight of the following : **[16]**

a) State the use of fopen( ) statement with the help of the example.

b) State the output of the following :

```
main ( )
{
    char c[2] = "A";
    printf("\n %c", c[0]);
    printf("\n %s", c);
}
```

c) Define B tree.

d) Define the following

i) primary index.

ii) foreign key.

e) State the output of the following

```
main ( )
{
    int b[ ] = {10, 20, 30, 40, 50};
    int i;
    for (i=0, i<=4; i++)
        printf("\n %d", *(b + i));
}
```

f) Explain the concept of macro with the help of suitable example.

P.T.O.

g) Define the following :

i) ancestor. ii) predecessor.

h) Explain sprint( ) function.

i) What is physical file organisation?

Q2) Attempt any two of the following : **[16]**

a) Write a program to read a file source. txt which has string data? Count the no. of uppercase letters, no. of lowercase letters, no. of digits and no. of special characters from the source. txt file & display it.

b) Write a program to check whether the given number is prime or no using function.

c) Write a program to find the number of times that a given word occurs in a sentence.

Q3) Attempt any four of the following : **[16]**

a) Differentiate between scanf["%s"], get char[ ] and gets[ ] functions.

b) Define DBMS. What are the advantages and disadvantages of DBMS?

c) Explain different file organization methods.

d) Explain the role of DBA in database.

e) Write a note on Database users.

Q4) Attempt any eight : **[16]**

a) Explain the following functions :

i) getchar ( ) ii) gets( )

b) Define macro.

c) What is an address operator? Give example.

d) Explain the concept of non-procedural DML.

e) Explain unclustered index with the help of example.

f) Explain any two file opening modes.

g) Differentiate between sequential access & random access files.

h) Define the following

i) primary index. ii) secondary index.

i) Give the prototype of

i) ftell ( ) ii) fseek ( )

Q5) a) Attempt any two : **[8]**

i) What are different ways of classifying a DBMS?

ii) What is the difference between procedural & non procedural DMLS?

iii) What is the difference between logical data independence & physical data independence?

b) Attempt any two : **[8]**

i) Define the following terms

1) entity 2) attribute

3) instance 4) composite attribute.

ii) Explain the use of following functions

1) fread ( ) 2) fwrite ( )

iii) Write a program to read a file input. txt which has data in uppercase. Convert it to lowercase & store it into output. txt.

Total No. of Questions : 5] **[Total No. of Pages : 2**

P886 [3635] - 205

M.Sc. Tech. - I

COMPUTER

Industrial Mathematics with Computer Applications

MIM - 205 : Data Structure Using C

(New Course)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any eight of the following : **[16]**

a) Define array. How to declare & initialize an array.

b) Convert expression into prefix form

i) (A * B) + C

ii) A / (B ^ C) + D

c) What do you mean by stack?

d) What is Priority queue? State types of priority queue.

e) Define link list. What are operations on link list?

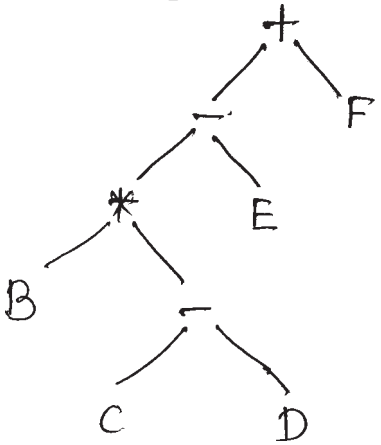
f) What is data structure & describe the term ADT?

g) Define the terms :

– Degree of node.

– Depth of node.

h) Which arithmetic expression does the given expression tree represent?



i) What is graph & explain representation of graphs using adjacency matrix?

j) What are applications of link list?

Q2) Answer any two of the following : **[16]**

a) Write a program in 'C' to accept 5 numbers from the user & sort using merge sort.

P.T.O.

b) Write a function for insertion & deletion of elements at any position in double link list.

c) Write a 'C' program to search an element in the array using linear search.

Q3) Answer <u>any four</u> of the following : **[16]**

a) Compare the data structures stack & queue.

b) Explain graph traversal methods with algorithm.

c) Write an algorithm to delete a given node at the front from a single linked list.

d) What is circular queue? Explain with example.

e) Write an algorithm for converting Infix to postfix using priority method.

Q4) Answer <u>any four</u> of the following : **[16]**

a) Construct Binary search tree for the following elements
15, 11, 13, 8, 9, 17, 16, 18

b) What is Stack? Define following terms :
- Stack overflow.
- Stack ADT.

c) Explain different tree traversals.

d) Explain algorithm for Binary search. Write a C program to search an element by using Binary search method.

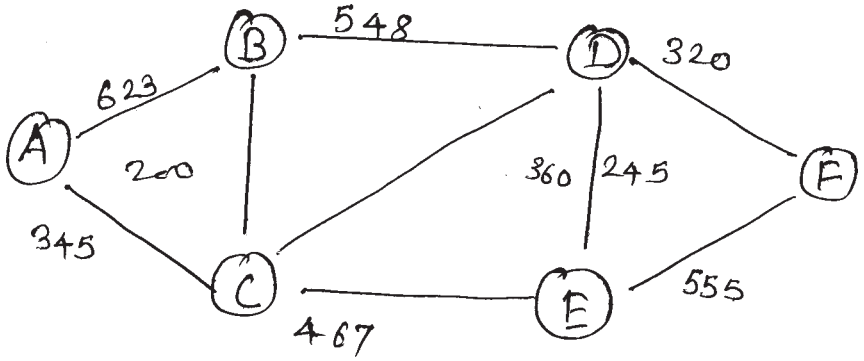
e) Write 'C' program for creating Doubly linked list.

Q5) Answer <u>any four</u> of the following : **[16]**

a) Differentiate between static & dynamic implementation of a linked list.

b) Explain implementation of queries in CPU scheduling algorithm. Explain Round Robin algorithm.

c) Create an adjacency matrix & adjacency list for the weighted graph shown



d) Explain selection sort algorithm. Illustrate it on the following array.
92 90 78 54 2

e) Write a function in C which compares the contents of two stacks & display the message accordingly.

Total No. of Questions : 5] **[Total No. of Pages : 2**

P886 [3635] - 205

M.Sc. Tech. - I

COMPUTER

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 205 : Data Structure Using C

(Old Course)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any eight of the following : **[16]**

a) Convert the expression into postfix form :
A + [(B + C) + (D + E) ∗ F] / G.

b) Define Graph.

c) Define the terms : Sibling, leaf node.

d) Give the node structure for a circular doubly linked list.

e) Illustrate the iterations of selection sort on the following array
23 15 29 11 1

f) Define : Almost complete Binary Tree.

g) Evaluate the following expressions where
a = 5, b = 3, c = 6, d = 8
i) a = c ∗ d/b. ii) ((a + b) ∗ (a – b)) / (a – b)

h) Represent the eq^n $[(x-4)5] / (3x+2)$ in the tree format.

i) What is Stack? Explain operations on stack.

j) What is abstract data types?

Q2) Answer any two of the following : **[16]**

a) What is Queue? What are operations on queue? Write an algorithm for insertion of an element in a queue.

b) What is Bubble sort? Write a C program for explaining Bubble sort technique.

c) Write an algorithm and C program for Doubly circular linked list for inserting node at the begining of list.

Q3) Answer any four of the following : **[16]**

a) Compare singly linked list and doubly linked list.

b) Write an algorithm and function for deleting the element from queue.

P.T.O.

c) Difference between Stack and Queue.
d) Write note on graph traversals.
e) Write algorithm for quicksort.

Q4) Answer any four of the following : **[16]**

a) What is Binary search Tree? What are operations commonly performed on Binary search tree. Write C program for recurssive search. BST.

b) Convert expression into prefix form :
   i) A / (B ∧ C) + D
   ii) (A ∗ B + (C/D)) – F.

c) What is linked list? What are operations on linked list? Write an algorithm for single linked list to insert a node at the begining.

d) Explain following terms :
   i) Adjacency matrix.
   ii) Adjacency list.

e) What is Quick sort? Write a program in C to accept 5 numbers from the user & sort using Quick sort.

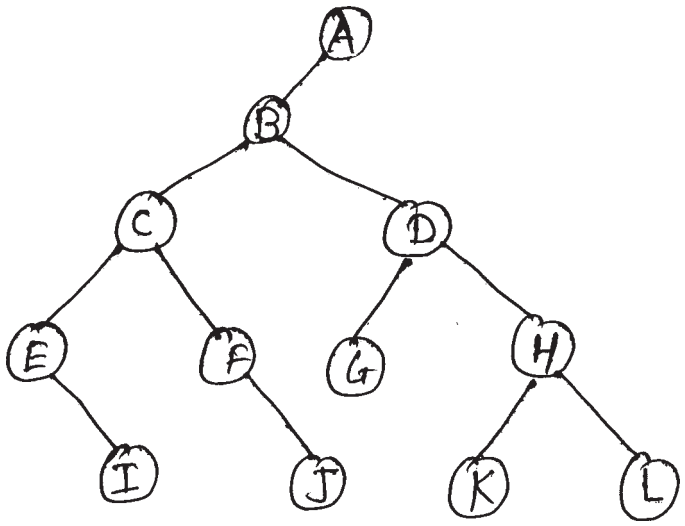
Q5) Answer any four of the following : **[16]**

a) Write note on array as an abstract data type what is 1 - diamentional & 2 - Diamentional array?

b) Explain linked list applications.

c) Write function in C to PUSH and POP operations on stack.

d)



From the given binary tree write the pre order, post order and In order traversal.

e) Write a recursive function C to find factorial of a given number, n!.

Total No. of Questions : 5] **[Total No. of Pages : 4**

P887

[3635] - 301

M.Sc. Tech.

MATHEMATICS

Industrial Mathematics with Computer Applications

MIM - 301 : Numerical Analysis

(New Course)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Use of non-programmable scientific calculator is allowed.***

Q1) Attempt any eight of the following : **[16]**

a) Find the absolute error and relative error in the approximation of $x = 2.71828182$ by $\tilde{x} = 2.7182$.

b) Find fixed point, if any, of $g(x) = -4 + 4x - \frac{x^2}{2}$.

c) Does the function $f(x) = e^x - 2 - x$, have a root in the interval (–2.4, –1.6)? Justify.

d) Find a real root of the equation $x^2 - 49 = 0$, by Bisection method, which lies in [4, 8].

e) Discuss Crout decomposition of a square matrix.

f) Write the formula for Lagrange interpolating polynomial through the points (x_0, y_0), (x_1, y_1) and (x_2, y_2).

g) Write first two Newton-cotes quadrature formulas.

h) Define a Householder matrix.

i) Show that matrix, $A = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix}$ is orthogonal.

j) Write down the equivalent system of two first order equations of the initial value problem,

$x''(t) + 4x'(t) + 5x(t) = 0$, with $x(0) = 3$ and $x'(t) = -5$.

P.T.O.

Q2) a) Attempt <u>any one</u> of the following : **[6]**

i) Let $P(x) = ((x^3 - 3x^2) + 3x) - 1$ and $Q(x) = ((x - 3)\,x + 3)x - 1$. Use three-digit rounding arithmetic to compute approximations to P(2.19) and Q(2.19). Compare them with the true values P(2.19) = Q(2.19) = 1.685159.

ii) Let $g(x) = x - 0.001x^2$. Start with $p_0 = 1$ and find p_1, p_2, p_3, p_4 and p_5 by using the fixed point iteration $p_{k+1} = g(p_k)$.

b) Attempt <u>any two</u> of the following : **[10]**

i) Let $f(x) = ln(x) - 5 + x = 0$; start with $[a_0, b_0] = [3.2, 4.0]$ and perform four iterations of False position method.

ii) Start with $f(x) = x^3 - A$; where A is any real number and derive the recursive formula

$$P_k = \frac{2P_{k-1} + A/P_{k-1}^2}{3};\ k = 1, 2, ...$$

for finding the cube root of A.

iii) Find the Jacobian matrix $J(x, y, z)$ of order 3 x 3 at the point (1, 3, 2) for the three functions,

$f_1(x, y, z) = x^3 - y^3 + y - z^4 + z^2$,

$f_2(x, y, z) = xy + yz + xz$,

$f_3(x, y, z) = \frac{y}{xz}$.

Q3) a) Attempt <u>any one</u> of the following : **[6]**

i) Express the system

$x_1 + 2x_2 + x_3 + 4x_4 = 13$

$2x_1 + 4x_3 + 3x_4 = 28$

$4x_1 + 2x_2 + 2x_3 + x_4 = 20$

$-3x_1 + x_2 + 3x_3 + 2x_4 = 6$

in augmented matrix form and find an equivalent upper-triangular system.

ii) Find the inverse of the matrix, $A = \begin{bmatrix} 2 & 0 & 1 \\ 3 & 2 & 5 \\ 1 & -1 & 0 \end{bmatrix}$.

Also check your answer by computing the product AA^{-1}.

b) Attempt any two of the following : **[10]**

i) Assume that $f \in C^3[a,b]$ and that $x - h, x, x + h \in [a, b]$, then prove the central difference formula,

$$f'(x)=\frac{f(x+h)-f(x-h)}{2h}.$$

ii) Let $f(x) = x^3 - 4x$. Construct the divided difference table on the node $x_0 = 1, x_1 = 2, x_2 = 3, x_3 = 4, x_4 = 5, x_5 = 6$.

iii) Use the numerical differentiation formula,

$$f''(x)=\frac{f(x+h)-2f(x)+f(x-h)}{h^2}$$

to approximate $f''(0.8)$ for the function $f(x) = \cos x$, with $h = 0.01$. Compare your result with the true value $f''(0.8) = -\cos(0.8)$.

Q4) a) Attempt any one of the following : **[6]**

i) Derive the composite Simpson's $\frac{1}{3}^{rd}$ rule in the form

$$\int_a^b f(x)\,dx=\sum_{k=1}^{M}\int_{x_{2k-2}}^{x_{2k}} f(x)dx=\sum_{k=1}^{M}\frac{h}{3}\left[f(x_{2k-2})+4f(x_{2k-1})+f(x_{2k})\right]$$

ii) Use Euler's method to solve $y'=\frac{t-y}{2}$ on [0, 3] with $y(0) = 1$, take $h = 1$.

b) Attempt any two of the following : **[10]**

i) Use the composite trapezoidal rule to compute an approximation to the integral of $f(x) = \sin x$ taken over $\left[0, \frac{\pi}{2}\right]$.

[Dividing the range into six equal parts].

ii) Use Runge-Kutta method of fourth order to solve the initial value problem $y' = t + y$, $y(0) = 1$, with $h = 0.1$ on [0, 0.1].

iii) Suppose that matrix

$$A=\begin{bmatrix} 3 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 3 \end{bmatrix}$$ has eigen values $\lambda_1 = 1, \lambda_2 = 3$ and $\lambda_3 = 4$ which correspond to the eigen vectors, $V_1 = (1, 2, 1)^T$, $V_2 = (1, 0, -1)^T$, $V_3 = (1, -1, 1)^T$ then show that A is diagonalizable.

Q5) Attempt any two of the following : **[16]**

a) Use power method to find the largest eigen value and the corresponding eigen vector of the matrix, $\begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$.

Start with $x^{(0)} = [1, 0, 0]^T$ and perform three iterations.

b) Use Jacobi's method to find the eigen pairs of the matrix, $\begin{bmatrix} -2 & -2 & 6 \\ -2 & 3 & 4 \\ 6 & 4 & -1 \end{bmatrix}$

Perform two iterations.

c) Use Householder's method to reduce the matrix

$$A = \begin{bmatrix} 1 & 3 & 4 \\ 3 & 2 & -1 \\ 4 & -1 & 1 \end{bmatrix}$$

to symmetric tridiagonal form.

Total No. of Questions : 5] **[Total No. of Pages : 3**

P887

[3635] - 301

M.Sc. Tech.

MATHEMATICS

Industrial Mathematics with Computer Applications

MIM - 301 : Topology

(Old Course)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Answer any eight of the following : **[16]**

a) Define a basis for a topology on a set X. Illustrate with an example.

b) Consider the set Y = [–1, 1] as a subspace of R. State whether the set $A=\left\{x \mid \frac{1}{2} \leq |x| < 1\right\}$ is open in Y? Is it open in R?

c) Show that the subset $[2,3] \cup \{6\}$ of R is closed.

d) Determine the closure of the set $K=\left\{\frac{1}{n} | n \in Z_+\right\}$ in R under the standard topology.

e) Suppose that $f: X \to Y$ is continuous. If x is a limit point of the subset A of X, is it necessarily true that $f(x)$ is a limit point of $f(A)$? Justify.

f) Is the set R with usual topology connected? Justify.

g) Show that the image of a compact space under a continuous map is compact.

h) Show that the real line R is locally compact.

i) Prove that a subspace of a first countable space is first countable.

j) Define a normal space. Give one example.

Q2) a) Answer any one of the following : **[6]**

i) Prove that the topologies of R_l and R_k are strictly finer than the standard topology on R, but are not comparable with one another.

ii) Prove that if A is a subspace of X and B is a subspace of Y then the product topology on A x B is the same as the topology A x B inherits as a subspace of X x Y.

P.T.O.

b) Answer <u>any two</u> of the following : **[10]**

i) Let X be a set and let τ be the collection of all subsets U of X such that X - U either is countable or is all of X. Show that τ is a topology on X.

ii) If $\{\tau_\alpha\}$ is a family of topologies on X, show that $\cap \tau_\alpha$ is a topology on X. Is $\cup \tau_\alpha$ a topology?

iii) Show that the projection maps $\pi_1 : X \times Y \to X$ and $\pi_2 : X \times Y \to Y$ are open maps.

Q3) a) Answer <u>any one</u> of the following : **[6]**

i) Let A be a subset of the topological space X and A' be the set of all limit points of A. Prove that $\overline{A} = A \cup A'$.

ii) Prove that the mapping $f : X \to Y$ between topological spaces is continuous if and only if for each $x \in X$ and each neighborhood V of $f(x)$, there is a neighborhood U of x such that $f(U) \subseteq V$.

b) Answer <u>any two</u> of the following : **[10]**

i) Show that a subspace of a Hausdorff space is Hausdorff.

ii) Show that the function $f : R \to R$ given by $f(x) = 3x + 1$ is a homomorphism.

iii) Show that the subspace (a, b) of R is homomorphic with (0, 1).

Q4) a) Answer <u>any one</u> of the following : **[6]**

i) Prove that a finite cartesian product of connected topological spaces is connected.

ii) Show that the product of two compact spaces is compact.

b) Answer <u>any two</u> of the following : **[10]**

i) Show that the space R^w is not connected in the box topology.

ii) Show that if $f : X \to Y$ is continuous, where X is compact and Y is Hausdorff, then f is a closed map.

iii) Show that the one point compactification of R is homomorphic with the circle S^1.

Q5) a) Answer <u>any one</u> of the following : **[6]**

i) Prove that a subspace of a regular space is regular and a product of regular spaces is regular.

ii) Prove that every metrizable space is normal.

b) Answer <u>any two</u> of the following : **[10]**

i) Show that the space R_l is first countable but not second countable.

ii) Show by an example that the product of two Lindelöf spaces need not be Lindelöf.

iii) Show that if ΠX_α is Hausdorff then so is X_α.

Total No. of Questions : 5] **[Total No. of Pages : 2**

P888 [3635] - 302

M.Sc. Tech.

COMPUTER

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 302 : Software Engineering (OOSE)

(Sem. - III) (New Course)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any eight of the following : **[16]**

a) Give the phases included in Generic view of Software Engineering.

b) List different process models.

c) Define the software reliability.

d) What are the three activities in requirement determination?

e) BBT (Black Box Testing) is used to find the errors like, - choose the correct alternative.

i) Interfacing errors.

ii) Initialization & termination errors.

iii) Performance error.

iv) Incorrect & missing function.

f) What is Agility?

g) State the different facts finding techniques in analysis phase.

h) What is unit testing?

i) Define -

i) Object. ii) Class.

j) List the sequence of events in prototyping model.

Q2) Attempt any four of the following : **[16]**

a) What is distributed System Architecture? Explain.

b) How Data models are useful, explain any one data model.

c) Explain four common design issues of a user Interface.

d) Data objects & object-oriented classes. Are they the same thing - Comment.

e) Explain the different roles performed by System Analyst.

P.T.O.

Q3) Attempt any four of the following : **[16]**

a) Write short note on object oriented design pyramid.

b) What is feasibility study? Explain the different types of feasibility study?

c) What is System Engineering? Give the System Engineering hierarchy.

d) Explain how RAD model is used to achieve rapid system development.

e) What is user interface prototype?

Q4) Solve any two : **[16]**

a) Consider a generalized library system.

Draw -

i) Use case diagram.

ii) Context level diagram.

iii) 1'st level DFD. (Data Flow Diagram)

b) Consider Hospital Management System. Patient gets admitted in the hospital. The system is used to maintain. In Patient Department (IPD), Out Patient Department (OPD), Patient record and bill of patient. It also manages important information about various words in the hospital like ICU, General, Private, Semi-Private & Delux.

Draw -

i) Context level diagram.

ii) DFD upto last level.

c) Write short note on -

i) The spiral model.

ii) Client - Server Architecture.

Q5) Attempt any four of the following : **[16]**

a) How behavioural models are helpful, explain.

b) Explain test data generators.

c) What is System Testing? Explain different types of system tests for software based system.

d) What do you mean by validation of a system?

e) Explain the attributes of good software.

Total No. of Questions : 5] **[Total No. of Pages : 3**

P888 [3635] - 302

M.Sc. Tech.

COMPUTER

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 302 : Fundamentals of Database Systems

(Old Course)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***All questions carry equal marks.***

Q1) Attempt any eight : **[16]**

a) Define : Schema.

b) What are data models?

c) Define : Entity with an example.

d) State the events on which a trigger can be fired.

e) Define : Closure of attribute sets.

f) What are non-trivial dependencies?

g) What is a hash function?

h) Give any 2 DML statements.

i) Give the structure of a PL/SQL block.

j) State the 4 mapping constraints between the Entities in an ER model.

Q2) a) Attempt any one : **[6]**

i) Draw an ER diagram for a Bank database. Each bank has multiple branches and each branch can have multiple accounts and loans.

Bank has code, name and address as its properties. Each branch has a number and location. Account of the customers has accout_no., balance and type. Branch provides loan to the customer so loan_no., amount and type needs to be recorded in the database.

Consider all possible relationship between the entities. Establish primary key in all the entities.

ii) Draw an ER diagram for the Book club. It has members to whom the books are sold. The books are made available at different places in the city. The books are identified by the book-id, the author and the publisher. An author can write more than one book and a book

P.T.O.

can have more than one author. Members have information such as membership-id, name, phone and status. A member can place more than one order. You can choose additional attributes that seem appropriate to the above scenario.

b) Attempt any two : **[10]**

i) How does a tuple relational calculus differ from domain relational calculus?

ii) Explain Normalization. Give all types of Normalization.

iii) Explain Discretionary access control.

Q3) Attempt any four : **[16]**

a) Explain B^+ tree index structure.

b) Explain any 4 Aggregate functions with an example.

c) Write a note on trigger.

d) What are the different techniques used for database security?

e) Explain the possible loop statements in PL/SQL with examples.

Q4) a) Attempt any one : **[6]**

i) Suppose that we decompose the schema R = (A, B, C, D, E) into (A, B, C) (A, D, E).

Show that this decomposition is a lossless - join decomposition if the following set F of functional dependencies holds :

$A \rightarrow BC$ $CD \rightarrow E$ $B \rightarrow D$ $E \rightarrow A$.

ii) Consider the following schema.

Works (Pname, cname, salary)

Lives (Pname, street, city)

Located-in (cname, city)

Manager (Pname, Manager name)

Solve the queries in Relational Algebra :

1) Find the names of the persons who live and work in the same city.

2) Find the names of the persons who do not work for 'Infosys'.

3) Find the persons whose salaries are more than that of all of the 'Oracle' company employees.

b) Attempt any two : **[10]**

i) Explain sequence in PL/SQL with an example.

ii) Explain referential integrity with an example.

iii) Explain different dynamic hashing techniques.

Q5) Attempt any four : **[16]**

a) Explain the different levels of the RAISE statement.

b) Write a short note on 'Parameterized Cursors'.

c) Explain : Generalization with example.

d) Consider the Schema.

Employee (Employer_no, name, date, designation, salary, dept_num)

Department (dept_num, dept_name)

Write a PL/SQL block to list the names of all employees who earn the maximum salary in the department.

e) Movie (Movie_num, name, release_year)

Actor (Actor_num, name, age)

Movie-Actor (Movie_num, actor_num, rate)

i) Write a trigger on movie table to check the constraint that the release-year should be greater than "01-01-2000".

ii) List all the name of the actors whose rate is greater than 1 lakh.

Total No. of Questions : 5] **[Total No. of Pages : 2**

P890 [3635] - 303

M.Sc. Tech.

COMPUTER

Industrial Mathematics with Computer Applications

MIM - 303 : Object Oriented Programming in JAVA

(Sem. - III) (New Course)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Answer any eight of the following : **[16]**

a) What is the relationship among C, C++ & JAVA?

b) What are command line arguments?

c) What do you mean by casting a value?

d) Describe Finalizer method.

e) Explain different visibility modifiers.

f) What is an event?

g) Define the term collection.

h) Name different byte stream classes.

i) 'A try block must have catch block' state true / false & justify.

j) Define an Exception.

Q2) Answer the following :

a) Explain the interface concept with suitable example. **[6]**

OR

Explain static members with suitable example.

b) Answer any two of the following : **[10]**

i) Differentiate between vector and Arrays.

ii) What is package? How can you create and use package?

iii) Explain stream and its types.

P.T.O.

Q3) Answer the following :

a) Explain Exception Handling. **[6]**

OR

Write a JAVA program using command line arguments which contains multiple catch blocks and throws an Arithmetic exception if zero (no) command line arguments are passed.

b) Answer any two of the following : **[10]**

i) What is the purpose of finally block in Exception handling?

ii) Explain the characteristics of constructor and state its types.

iii) Write a program which will override any method.

Q4) Answer the following :

a) Write a JAVA program which will display 5 buttons using Flow Layout manager. **[6]**

OR

Explain Event Listener Interfaces.

b) Answer any two of the following : **[10]**

i) Explain AWT controls in brief.

ii) Describe Swing features.

iii) Explain the use of "Super" keyword.

Q5) Answer the following :

a) With the help of collection classes write a JAVA program to build Linked List which adds and removes some elements and displays output each time. **[6]**

OR

Explain Arraylist class with suitable example.

b) Answer any two of the following : **[10]**

i) What is an Inheritance? Explain its types in brief.

ii) Differentiate between overloading and overriding a method.

iii) Explain Wrapper classes.

Total No. of Questions : 5] **[Total No. of Pages : 4**

P890

[3635] - 303

M.Sc. Tech.

COMPUTER

Industrial Mathematics with Computer Applications

MIM - 303 : Object Oriented Concepts with C++

(Sem. - III) (Old Course)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Answer any eight **[16]**

a) Write a declaration statement to make a function show ( ) as a virtual function. State its purpose.

b) Define late binding and early binding.

c) State how do you make a class as an abstract class. Also define an abstract class.

d) State the situations when a copy constructor is invoked.

e) Define polymorphism, with an eg.

f) Define a friend function, with an eg.

g) If a base class and a derived class, each include a member function with the same name, which member function will be called by an object of the derived class, assuming the scope resolution operator is not used. Justify your answer.

h) Assume there is a class Derv, that is derived from a base Class Base. Write the declarator for a derived Class Constructor that takes one argument and passes this argument along to the constructor in the base class.

i) Write a statement that a member function can use, to return the entire object of which its a member, without creating, any temporary objects.

j) Define a pure virtual function, with an eg.

Q2) Attempt any four **[16]**

a) Explain the new and delete operators with an eg.

b) Write a short note on Reference variables, with an eg.

P.T.O.

c) Is it possible to make a class as friend to another class, justify with an eg.

d) Define a state function. State the need for defining state functions, with an eg.

e) Write a short note on Exception handling in C++. Illustrate with an eg.

Q3) Attempt <u>any two</u> **[16]**

a) Write a C++ program, which has a string class defined as

```
Class String {
        Char *S; int len;
        Public : String (int = 0)
                // default constructor
        String (const char *) // constructor
        String (const string &) // copy constructor
        }
```

Write functions for the above constructors & functions to

i) Overload ~ for changing the case of the string.

ii) Overload insertion & extraction operators for accepting and displaying the strings.

Use the above functions in Main ( ), to illustrate its usage.

b) Write a C++ program to create a class person (name, address, phone no.). Write member functions to accept and display data. Design two derived classes employee (e-no.) and manager (designation, department and basic salary).

Write a menu driven program to accept details of *n* managers and display their details.

c) Define a class item. Include the following members :

Data members : Code, name, price, quantity and amount.

Member functions :

i) To get values.

ii) To calculate total amount.

iii) To display details of a single item.

iv) To display details of *n* items.

Write a menu driven program to test the above class & its functions.

Q4) Attempt <u>any four</u> **[16]**

a) Point out the errors, if any in the following code, and rewrite.

```
# include < iostream .h>
void f (int = 10, int = 20, int = 30);
void f (int, int);
void main ( )
{f(1, 2);}
void f(int x, int y, int z)
{Cont << endl << x << endl << y << endl << z;}
void f (int x, int y)
{Cont << endl << x << endl << y;}
```

b) Write an overloaded function to find the sum of two integers, sum of two floats, sum of two strings. Use the concept of reference variables in function arguments.

c) Consider the following class definition

Class example {int x;}

Define default, one-arg, copy constructors for the above class. Overload the + operator to perform the following operation

$O_3 = O_1 + O_2$, where O_1, O_2, O_3 are objects of the class example.

d) Explain the concept of virtual destructors, with an example.

e) Write a short note on function templates, with special emphasis on its distinction from overloaded functions.

Q5) Attempt <u>any two</u> **[16]**

a) Create a class matrix, which stores a matrix of integers of a given size (default size = 3)

Define default, argument constructors for the above class.

Write necessary member functions to overload the following operators :

+ Adds two matrices and stores in the 3rd matrix.

== Return 1 if the two matrices are same, otherwise 0.

<< Prints the matrix.

>> Reads the matrix into the array.

Write a main ( ) to test the above class and its functions.

b) Write a menu driven program to perform operations on a binary file "Student.dat", which contains roll number, name, project name, rank, front end, back end. Write necessary constructor & destructor functions, to load the contents of the file into an array of student objects & save the contents back to the file respectively. The first line of the file stores the total number of student records. The following operations need to be done :

i) Display details of all students.

ii) Display details of a single student.

iii) Display the student with the highest rank.

iv) Modify details of one student.

c) Write a short note on the concept of inheritance in C++, with an eg on each type of inheritance.

Total No. of Questions : 5] **[Total No. of Pages : 3**

P891 **[3635] - 304**

M.Sc. Tech.

COMPUTER

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 304 : Operating Systems

(New Course)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any eight of the following : **[16]**

a) Name necessary conditions for deadlock.

b) Define context switch.

c) What is page fault?

d) List the attributes of file.

e) State the contents of PCB.

f) What is an I/O bound process?

g) Define thread cancellation. List the two scenarios of thread cancellation.

h) Define overlays.

i) What is DMA? When it is used?

j) What is fragmentation?

Q2) Attempt any four of the following : **[16]**

a) Five jobs arrive at time 0, in the order given

Jobs	Burst time
1	10
2	29
3	3
4	7
5	12

i) Draw Gantt chart using non-pre-emptive SJF algorithm & Round Robin algorithm (Time Quantum = 10).

ii) Calculate average waiting time for SJF (non-pre-emptive).

iii) Calculate average waiting time for Round Robin.

P.T.O.

b) Consider the segment table

Segment	Base	Length
0	219	600
1	2300	14
2	90	100
3	1327	580
4	1952	96

What are the physical addresses for following logical addresses?

i) 0, 430

ii) 4, 112

iii) 3, 400

c) Explain Logical address and physical address. How logical address is converted to physical address in paging.

d) List the types of threads. State the benefits of multithreaded programming.

e) Explain FCFS (First Come First Served) scheduling algorithm.

Q3) Attempt <u>any four</u> of the following : **[16]**

a) Consider a disk queue with requests for following cylinders.

86, 147, 91, 170, 95, 130, 102, 70

Suppose that the disk has 200 cylinders numbered 0 to 199 and head is presently at cylinder 125.

Find the total head movement using

i) FCFS Disk scheduling.

ii) SSTF Disk scheduling.

b) Explain indexed allocation file access method in detail.

c) What is memory compaction & how it is used?

d) What is dispatcher? Explain its function.

e) Write a short note on race condition.

Q4) Attempt <u>any four</u> of the following : **[16]**

a) What is an operating system? What are the purposes of operating system?

b) What is page fault? Describe the actions taken by operating system when page fault occurs?

c) What is schedular? Describe each type of schedular in brief.

d) Explain the 'Second Chance' page replacement algorithm.

e) Consider the following snapshot of a system. A, B, C & D are resource types.

	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P_0	0	0	1	2	0	0	1	2	1	5	2	0
P_1	1	0	0	0	1	7	5	0				
P_2	1	3	5	4	2	3	5	6				
P_3	0	6	3	2	0	6	5	2				
P_4	0	0	1	4	0	6	5	6				

Answer the following questions using Banker's algorithm.

i) What is the content of need array?

ii) Is the system in safe state? If yes give the safe sequence.

Q5) Answer <u>any four</u> of the following : **[16]**

a) Given below are the arrival jobs status to be executed by a single processor.

Job Arrival	Arrival Time	CPU burst time
1	0.0	8
2	0.5	5
3	1.0	2

Each job runs for the listed amount of time. What is average turn around time if no pre-emptive scheduling is used for the following?

i) FCFS

ii) SJF.

b) Write a note on semaphores.

c) Write a note on swapping.

d) What is an interrupts? Discuss interrupt-driven I/O cycle.

e) Write a note on segmentation.

Total No. of Questions : 5] **[Total No. of Pages : 3**

P891 [3635] - 304

M.Sc. Tech.

COMPUTER

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 304 : Operating Systems - I

(Old Course)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any eight of the following : **[16]**

a) Define safe state.

b) Give any two difference between pre-emptive and non-pre-emptive scheduling.

c) Define Turn Around Time.

d) What is fragmentation?

e) What is lazy swapper?

f) What is a file? List any two file attributes.

g) What is 'thread cancellation'?

h) What are seek time and latency time?

i) What is a semaphor?

j) Name the different scheduling queues.

Q2) Attempt any four of the following : **[16]**

a) Consider the following snapshot.

Process	Burst Time
P_1	10
P_2	1
P_3	2
P_4	1
P_5	5

P.T.O.

i) Draw Gantt chart using non-pre-emptive SJF and Round Robin (Time quantum = 1) algorithm.

ii) Calculate average turn around time for SJF & Round Robin.

b) Consider the following reference string 4, 3, 2, 1, 4, 3, 5, 4, 3, 2, 1, 5. How many page faults occurs for the following algorithms with 3 page frames.

i) FIFO.

ii) LRU.

iii) Optimal.

c) Explain shortest-job-first scheduling.

d) Write a note on recovery from deadlock.

e) Explain the criteria used in judging the performance of a CPU scheduling algorithm.

Q3) Attempt any four of the following : **[16]**

a) A process reference 5 page A, B, C, D & E in the following order

A, B, C, D, A, B, E, A, B, C, D, E

Assume that the page replacement algorithm is FIFO and find the number of page transfer during this sequence of reference string with an empty main memory with 3 and 4 page frames.

b) What is process? State and explain different types of process states.

c) State the advantages and disadvantages of contiguous memory allocation method.

d) Distinguish between long term scheduler and short term scheduler.

e) Write a note on virtual memory concept.

Q4) Attempt <u>any four</u> of the following : **[16]**

a) Write a note on multiprocessor system.

b) What is critical section problem?

c) Explain functioning of multilevel queues.

d) Write a note on demand paging.

e) Consider the following snapshot of a system.

	Allocation			Max		
	A	B	C	A	B	C
P_0	0	1	0	7	5	3
P_1	2	0	0	3	2	2
P_2	3	0	2	9	0	2
P_3	2	1	1	2	2	2
P_4	0	0	2	4	3	3

At time t_0, the resource A has 10 instances, B has 5 instances and C has 7 instances.

i) What are the contents of array need?

ii) Check whether the system is in safe state.

Q5) Answer <u>any four</u> of the following : **[16]**

a) Consider snapshot of the system

Job	Arrival Time	Burst Time
1	0	8
2	1	4
3	2	9
4	3	5

i) Draw Gantt chart using pre-emptive SJF & non-pre-emptive SJF.

ii) Calculate average turn around time using pre-emptive SJF & non-pre-emptive SJF.

b) List the types of threads. State the benefits of multithreaded programming.

c) Write a short note on

i) semaphore.

ii) segmentation.

d) Explain necessary conditions for a deadlock to occur.

e) Explain Tree structured directories of file system.

Total No. of Questions : 5] **[Total No. of Pages : 4**

P892 [3635] - 305

M.Sc. Tech.

COMPUTER

Industrial Mathematics with Computer Applications

MIM - 305 : Theoretical Computer Science

(New Course) (Sem. - III)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any eight of the following : **[8 x 2 = 16]**

a) Describe the language denoted by the regular expression abb*a and give two strings that do not belong to the language.

b) Let $X=\{\in, b, ab\}$, list the strings of length three in X^*.

c) Define Mealy machine.

d) Give examples of languages L_1 and L_2 over $\{a, b\}$ where L_1 is regular, L_2 is not regular but $L_1 \cup L_2$ is regular.

e) Let G be the grammar with productions $\{S \to abSc / A, A \to cAd / cd\}$. Give a derivation of *ababccddcc*.

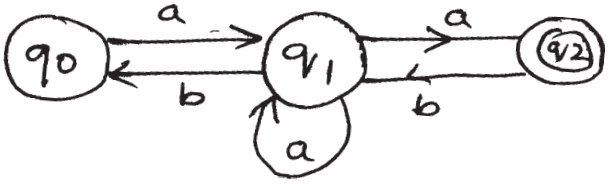
f) Describe the language generated by the grammar

$\{S \to aSbb / A,\ A \to cA / c\}$ using set notation and give two strings of the language.

g) State pumping lemma for regular languages.

h) Push down automata is a six tuple. Justify.

i) Construct a regular grammar for the following NFA.



j) Define Moore machine.

P.T.O.

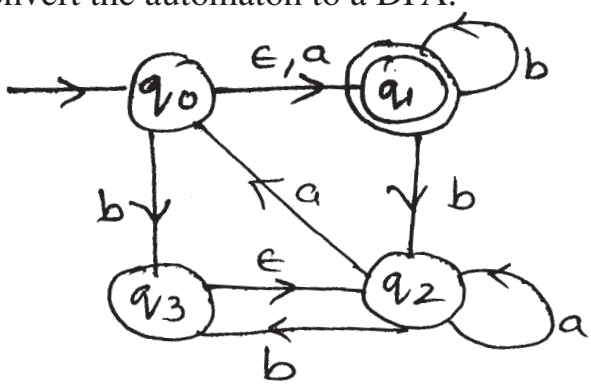
Q2) a) Attempt <u>any one</u> of the following : **[1 x 6 = 6]**

i) Construct DFA for the languages described below

A) The set of strings over $\{a, b\}$ that do not begin with substring aaa.

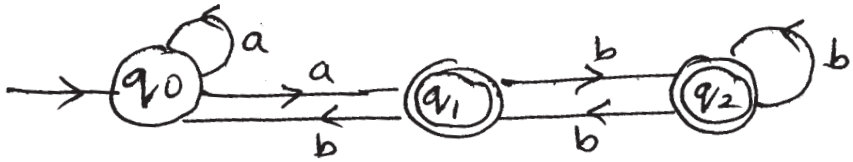
B) The set of strings over {a, b} in which the number of a's is divisible by three.

ii) For the following $\in$ - NFA, compute $\in$ - closure of each state and convert the automaton to a DFA.



b) Attempt <u>any two</u> of the following : **[2 x 5 = 10]**

i) Let M be the NFA.



Construct transition table for M and convert NFA to DFA.

ii) Construct NFA for the following languages

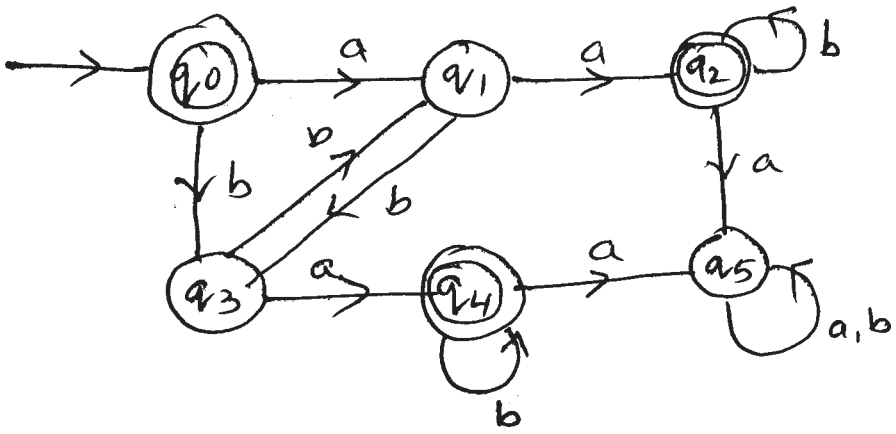
A) The set of strings over $\{a, b\}$ whose second last symbol is b.

B) The set of strings over $\{a, b\}$ which begin and end with the same symbol.

iii) For the regular grammar $G:\{S \rightarrow aS / bA / a,\ A \rightarrow aS / bA / b\}$, build an NFA that accepts the language L(G). Give a regular expression for L(G).

Q3) a) Attempt <u>any one</u> of the following : **[1 x 6 = 6]**

i) Minimize the following FA and informally describe the language it accepts.



ii) Qualify true or false and justify each of the following statements.

A) Complement of a regular language is regular.

B) For every Moore machine there is an equivalent Mealy machine.

C) Deterministic PDA and nondeterministic PDA accept the same set of languages.

b) Attempt <u>any two</u> of the following : **[2 x 5 = 10]**

i) Design Moore machine which takes input over $\{a, b\}^*$ and outputs 0 when the number of *a*'s in the input string are odd and *e* wherever number of *a*'s are even.

ii) Show that the language $\left\{w_1^n \,/\, w \in \{0,1\}^*, |w| = n, n > 0\right\}$ is not regular.

iii) Explain Chomsky hierarchy.

Q4) a) Attempt <u>any one</u> of the following : **[1 x 6 = 6]**

i) Show that the set of context tree languages is closed under union but not intersection.

ii) Convert CNF grammar given by

$\{S \to BA,\ A \to AB / a,\ B \to BB / b\}$ to Creibach Normal form.

b) Attempt <u>any two</u> of the following : **[2 x 5 = 10]**

i) Convert the grammar given by productions

$\{S \to aAbB / aBa / a,\ A \to aA / B / a,\ B \to bBbA / b\}$

to Chomsky normal form.

ii) What are useful symbols? Eliminate useless symbols from the grammar with productions

$\{S \to AA / CD / bB,\ A \to aA / a,\ B \to bB / bC,\ C \to cB,\ D \to dD / d\}$

iii) What are Nullable symbols? For the grammar G with set of productions $\{S \to BSA / A,\ A \to aA / \in,\ B \to Bba / \in\}$ find Nullable symbols and construct an equivalent non contracting grammar.

Q5) a) Attempt <u>any one</u> of the following : **[1 x 6 = 6]**

i) Construct CFG equivalent to PDAM = $(\{q_0, q_1\}, \{a, b\}, \{z\}, \delta, q_0, \phi)$ where δ is given as follows

$\delta(q_0, a, Z) = (q_0, ZZ)$, $\delta(q_0, b, Z) = (q_1, \in)$, $\delta(q_1, b, Z) = (q_1, t)$, $\delta(q_1, \in, Z) = (q_1, \in)$.

ii) Construct a Turing machine which recognises the language $L = \{a^n b^m c^n / m, n \geq 0\}$

b) Attempt <u>any two</u> of the following : **[2 x 5 = 10]**

i) Show that $L = \{a^m / m = n^2, n \geq 1\}$ is not a CFL.

ii) Construct an equivalent PDA for the grammar in GNF with productions $\{S \to aABA / aBB,\ A \to bA / b,\ B \to cB / c\}$.

iii) Construct a PDA that accepts the language.

$\{WCW^R / W \in \{a, b\}^*$ and W^R is reverse of $W\}$.

Total No. of Questions : 5] **[Total No. of Pages : 3**

P892

[3635] - 305

M.Sc. Tech.

COMPUTER

Industrial Mathematics with Computer Applications

MIM - 305 : Design and Analysis of Algorithms - I

(Old Course) (Sem. - III)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any eight of the following : **[8 x 2 = 16]**

a) Define Ω notation. Give a sorting algorithm of $\Omega(n)$.

b) What is accounting method of amortized analysis?

c) Explain activity selection problem. What is the greedy strategy for getting optimal solution to this problem?

d) Show that $\log(n!) = O(n\log n)$.

e) Find a simple formula for $\sum_{k=1}^{n} 2k-1$.

f) What is a flow network? What is flow conservation property?

g) Explain parenthesis property satisfied by vertices in a DFS.

h) What is a heap? Is the sequence (20, 17, 15, 5, 6, 12) a heap?

i) What is an optimization problem? What is optimal substructure property?

j) Define articulation point and bridge.

Q2) Attempt any two of the following : **[2 x 8 = 16]**

a) Explain 'Divide and conquer' strategy. A is a sorted a may of n distinct integers. Devise an algorithm using divide and conquer strategy to determine an index i such that $1 \le i \le n$ and $A[i] = i$, provided such an index exists. Derive its time complexity.

b) What is multi-pop operation? What is its time complexity? Explain the potential method of amortized analysis and illustrate it on data structure stack with push, pop and multipop operations.

c) Write insertion sort algorithm. Obtain the cost of executing each statement. Derive the best case and worst case running time for the same.

P.T.O.

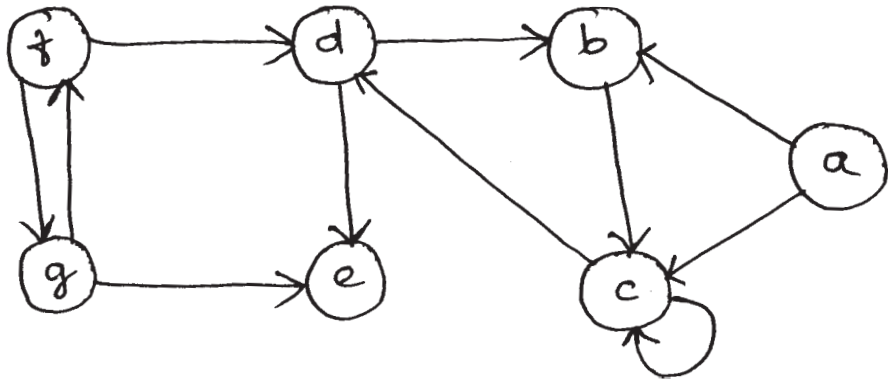
Q3) Attempt <u>any two</u> of the following : **[2 x 8 = 16]**

a) What are prefix codes? Explain Huffman coding algorithm for constructing optimal prefix codes. Obtain optimal Huffman codes for the following set of frequencies for 6 words M_1, M_2,.....M_6 in a file.

M_1	M_2	M_3	M_4	M_5	M_6
50	100	20	200	10	30

b) Explain longest common subsequence problem. Give the recurrence relation for the value of optimal solution in dynamic programming formulation of LCS problem. Give the algorithm to compute values of optimal solution in bottom up manner. Compute the values for $x = (1, 0, 0, 1)$ and $y = (0, 1, 0, 0)$.

c) Explain classification of edges using DFS. Classify the edges of the following graph.



Q4) Attempt <u>any four</u> of the following : **[4 x 4 = 16]**

a) Consider the following algorithm

```
Algorithm DQ(n)
{ if n = 1 then return
  for i = 1 to 9 do
      {DQ(n/3)
        for i = 1 to n^2 do x = x + 1
      }
  return
}
```

Get the recurrence relation for time taken by algorithm DQ and solve it using Master's theorem.

b) State Master's theorem and illustrate with an example that it is not applicable in all cases.

c) How array is partitioned in Quicksort algorithm? Write the partition algorithm.

d) Define θ notation. For nonnegative functions $f(n)$ and $g(n)$, prove that $\max(f(n), g(n)) = \theta(f(n) + g(n))$.

e) Explain counting sort algorithm. Illustrate it on the array

A = {5, 0, 2, 0, 1, 3, 4, 5, 1, 3, 2}.

f) For the fractional knapsack problem with n = 6, m = 20, profits p = (20, 16, 18, 12, 10, 5) and weights w = (10, 5, 6, 6, 4, 5), obtain optimal solution using greedy strategy.

Q5) Attempt <u>any four</u> of the following : **[4 x 4 = 16]**

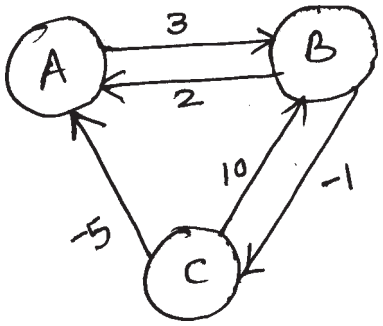
a) Explain BFS algorithm. What is its time complexity?

b) What are strongly connected components? Give the algorithm to compute strongly connected components using DFS.

c) Compare and contrast Prim's and Kruskal's algorithm for finding minimum spanning tree.

d) Show with an example that the running time complexity of Ford-Fulkerson algorithm depends on the choice of augmenting path.

e) Illustrate Floyd Warshall algorithm on the following graph.



f) Explain Dikstra's algorithm for shortest path calculation.

Total No. of Questions : 5] **[Total No. of Pages : 3**

P893

[3635] - 401

M.Sc. Tech.

MATHEMATICS

Industrial Mathematics with Computer Applications

MIM - 401 : Functional Analysis

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Answer any eight of the following : **[16]**

a) If $x_1, x_2, \ldots\ldots\ldots\ldots x_n$ are orthogonal, then

$$\|x_1 + x_2 + \ldots\ldots\ldots + x_n\|^2 = \|x_1\|^2 + \ldots\ldots\ldots + \|x_n\|^2.$$

b) Show that, if V = R^n then $\|x\|_\infty = \max_{1 \le i \le n} \{|x_i|\}$ defines a norm on V = R^n.

c) State Minkowski's inequality.

d) State and prove the parallelogram law for Hilbert spaces.

e) Show that in a Hilbert space $S \cap S^\perp = \{0\}$.

f) In a normed linear space N, prove that $|\|x\| - \|y\|| \le \|x - y\|$, for all x, y in N.

g) Define a normal operator.

h) Let T be a self adjoint operator on a Hilbert space H. Prove that αT is self adjoint if and only if α is real.

i) For adjoint operation $T \to T^*$ on B(H) prove that $(T_1 + T_2)^* = T_1^* + T_2^*$.

j) If A_1 and A_2 are self adjoint operators on a Hilbert space H, then show that A_1A_2 is self adjoint if and only if $A_1A_2 = A_2A_1$.

Q2) a) Answer any one of the following : **[6]**

i) Prove that a finite normed linear space is Banach space.

ii) If T is operator on H a Hilbert space, for which $(Tx, x) = 0$ for all $x \in H$, then prove that $T \equiv 0$.

b) Attempt any two of the following : **[10]**

i) Let N be a non-zero normed linear space, then prove that N is Banach space if and only if the set $\{x / \|x\| = 1\}$ is complete.

P.T.O.

ii) If N_1 and N_2 are normal operators on H with the property that either commutes with the adjoint of the other, then prove that N_1+N_2 and N_1N_2 are normal operators.

iii) Let S be a non-empty subset of a Hilbert space show that $S^{\perp} = S^{\perp\perp\perp}$.

Q3) a) Attempt <u>any one</u> of the following : **[6]**

i) State and prove open mapping theorem.

ii) Define an adjoint T^* of an operator T on H. Prove that T^* is linear and continuous on H, a Hilbert space.

b) Attempt <u>any two</u> of the following : **[10]**

i) Let $\{e_1, e_2, \ldots\ldots e_n\}$ be a finite orthonormal set in a Hilbert space H, and if x is any vector in H, then prove that $\sum_{i=1}^{n} |< x, e_i >^2| \leq \|x\|^2$.

ii) Prove that if N is finite - dimensional normed linear space of dimension n, show that N^* also has dimension n.

iii) Prove that if $1 < p < \infty$, then $\left(l_p^n\right)^* = l_q^n$.

Q4) a) Attempt <u>any one</u> of the following : **[6]**

i) If x and y are any two vectors in a Hilbert space, prove that $|< x, y >| \leq \|x\|.\|y\|$.

ii) Prove that if M is a closed linear subspace of a Hilbert space H, then $H = M \oplus M^{\perp}$.

b) Attempt <u>any two</u> of the following : **[10]**

i) Let N be a normed linear space over F and 'x' a fixed vector in N, Define a map $F_x : N^* \rightarrow F$, by $F_x(f) = f(x)$. Show that F_x is linear map and the map $x \rightarrow F_x$ is norm preserving from N to N^{**}.

ii) If M and N are closed linear subspaces of a Hilbert space H such that $M \perp N$. Then show that the linear subspace M + N is closed.

iii) Let M be a closed linear subspace of a normed linear space N. If the norm of the coset x + M in a quotient space N/M is defined as $\|x + M\| = \inf\{\|x + m\| / m \in M\}$ —— ⊛ then show that ⊛ actually defines a norm on N/M.

Q5) a) Answer <u>any one</u> of the following : **[6]**

i) Prove that an operator T on a Hilbert space H is normal if and only if its real and imaginary parts commutes.

ii) If M is a linear subspace of a Hilbert space, show that M is closed if and only if $\mathbf{M}=\mathbf{M}^{\perp\perp}$.

b) Answer <u>any two</u> of the following : **[10]**

i) State and prove closed graph theorem.

ii) If M is closed linear subspace of a normed linear space N, and if T is the natural mapping of N onto N/M; defined by $T(x) \rightarrow x + M$. Show that T is continuous linear transformation for which $\|T\| \leq 1$.

iii) In a Hilbert space H, show that

$$4 < x, y > = \|x + y\|^2 - \|x - y\|^2 + i\|x + iy\|^2 - i\|x - iy\|^2.$$

Total No. of Questions : 5] **[Total No. of Pages : 4**

P894

[3635] - 402

M.Sc. Tech.

MATHEMATICS

Industrial Mathematics with Computer Applications

MIM - 402 : Operations Research

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any Eight of the following : **[16]**

a) Can a L.P.P. have exactly two optimum solutions? Justify.

b) Find one basic solution for the following system of simultaneous equations :

$2x_1 + 3x_2 + 4x_3 = 5,\ 3x_1 + 4x_2 + 5x_3 = 6.$

c) What are scarce and abundant resources?

d) What is an unbalanced transportation problem? How do you balance it?

e) Define an assignment problem.

f) Can there be multiple solutions to an assignment problem? How would you identify?

g) Define the following :

i) Payoff matrix.

ii) Value of a game.

h) Explain the rule of dominance used in the game theory.

i) Solve the following game :

$$\begin{array}{cc} & \begin{array}{ccc} & B & \\ B_1 & B_2 & B_3 \end{array} \\ \begin{array}{c} \\ A \end{array} & \begin{array}{c} A_1 \\ A_2 \\ A_3 \end{array} \begin{bmatrix} 15 & 2 & 3 \\ 6 & 5 & 7 \\ -7 & 4 & 0 \end{bmatrix} \end{array}$$

j) Define earliest start time and earliest completion time of an activity in a network.

P.T.O.

Q2) Attempt <u>any two</u> of the following : **[16]**

a) Explain the following for a L.P.P.

i) Slack variable.

ii) Surplus variable.

iii) Artificial variable.

iv) Degenerate solution.

b) Solve the following L.P.P. by simplex method :

Max $Z = 4x_1 + 10x_2$

Subject to,

$2x_1 + x_2 \leq 10$

$2x_1 + 5x_2 \leq 20$

$2x_1 + 3x_2 \leq 18$

$x_1, x_2 \geq 0.$

Find alternative solution if exists.

c) Write the dual of the following L.P.P. and solve it using graphical method :

Max $Z = x_1 + x_2 + x_3$

Subject to,

$3x_1 + 2x_2 + x_3 \leq 3$

$2x_1 + x_2 + 2x_3 \leq 2$

$x_1, x_2, x_3 \geq 0.$

Q3) Attempt <u>any two</u> of the following : **[16]**

a) Find the initial solution of the following transportation problem using VAM. Hence find the optimum solution :

		To I	II	III	Supply
	A	5	1	7	10
From	B	6	4	6	80
	C	3	2	5	15
	Demand	75	20	50	

b) i) Explain the least cost method for obtaining an initial solution of a Transportation problem.

ii) Solve the following game :

		B	
		B_1	B_2
A	A_1	6	1
	A_2	–3	2

c) Solve the following game using graphical method :

		B		
		B_1	B_2	B_3
A	A_1	1	3	11
	A_2	8	5	2

Q4) Attempt <u>any two</u> of the following : **[16]**

a) i) Solve the following assignment problem :

	A	B	C	D
1	5	3	2	8
2	7	9	2	6
3	6	4	5	7
4	5	7	7	8

ii) Define 3 time estimates of a PERT activity. Also state the formulae for expected mean time and variance of an activity.

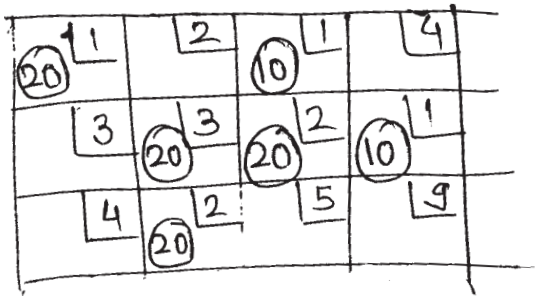
b) A project consists of 9 activities A, B, ... I. The table below gives the relationship and duration of all the activities :

Activity	A	B	C	D	E	F	G	H	I
Predecessor Activity	–	A	B	B	C	D	C	E,F	G,H
Duration	5	7	2	3	1	2	1	3	10

Draw a project network & Find critical path. Also find total float for all the activities.

c) i) What is degeneracy in a Transportation problem? How do you resolve it?

ii) Following table gives solution of a TP.



Show that the solution is optimum and find an alternative optimum solution if it exists.

Q5) Attempt any two of the following : **[16]**

a) A project consists of 7 activities whose time estimates are given in the following table :

Activity	Time required (in days)		
	t_o	t_m	t_p
1 - 2 (A)	6	6	24
1 - 3 (B)	6	12	18
1 - 4 (C)	12	12	30
2 - 5 (D)	6	6	6
3 - 5 (E)	12	30	48
4 - 6 (F)	12	30	42
5 - 6 (G)	18	30	54

i) Draw a project network.

ii) Find expected duration and variance of each activity.

b) Consider the following L.P.P.

Max $Z = 3x_1 + x_2 + 4x_3$

Subject to,

$6x_1 + 3x_2 + 5x_3 \leq 25$

$3x_1 + 4x_2 + 5x_3 \leq 20.$

$x_1, x_2, x_3 \geq 0.$

The optimal solution is $(x_1, x_3)^T$ and the optimal inverse is $\begin{bmatrix} 1/3 & -1/3 \\ -1/5 & 2/5 \end{bmatrix}$

Find the maximum change in the RHS of constraint 1, so that the current solution remains feasible and optimum.

c) For question no. 5-b) find the new optimum and feasible solution if the cost co-efficient of x_3 changes from 4 to 1.

Total No. of Questions : 5] **[Total No. of Pages : 2**

P895

[3635] - 403

M.Sc. Tech. (IMCA)

COMPUTER SCIENCE

MIM - 403 : Object Oriented Programming with Java

(Sem. - IV)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Answer any Eight of the following : **[16]**

a) How Java is compiled and interpreted language?

b) What is JVM?

c) Mention the advantages of vectors over arrays.

d) Name the different wrapper classes.

e) What is JDK?

f) What are final variables, methods & classes?

g) Name any 4 character stream classes.

h) Define Thread.

i) Explain Garbage collector in JAVA.

j) State any two characteristics of object oriented programming language.

Q2) Answer the following :

a) Define Interface & syntax of implementing interfaces with suitable example. **[6]**

OR

Write a JAVA program to calculate the area of Rectangle and circle with the interface named Area.

b) Answer any two of the following **[10]**

i) Explain wrapper classes.

ii) Write short note on Access modifiers.

iii) What is package? How can you create and use package?

P.T.O.

Q3) Answer the following :

a) Differentiate between 'throw' and 'throws'. **[6]**

OR

Name the different exception types and their meaning.

b) Answer any two of the following **[10]**

i) Explain finalizer method.

ii) Explain method overloading with suitable example.

iii) Write a JAVA program which will handle window events.

Q4) Answer the following : **[6]**

a) Write a JAVA program which will print the student marksheet using Interface sports. Class student contains rollnumber. Inherit Test class from it. It should contain marks of part1 and part2. Interface sports contains sports weightage. Inherit Result class from Test class having display method.

OR

What is AWT & its various components?

b) Answer any two of the following : **[10]**

i) Describe Life cycle of a thread.

ii) Explain the different swing controls.

iii) Differentiate between AWT and Swing.

Q5) Answer the following

a) Explain Treeset class and its constructors using suitable example. **[6]**

OR

What is JDBC and its advantages?

b) Answer any two of the following : **[10]**

i) Explain BorderLayout manager.

ii) State the advantages of multithreading over multitasking.

iii) Explain synchronization with example.

Total No. of Questions : 5] **[Total No. of Pages : 2**

P896 [3635] - 404

M.Sc. Tech.

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 404 : Operating Systems - II

(Sem. - IV)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any eight of the following : **[8 x 2 = 16]**

a) Define Buffer Cache.

b) Give syntax of following system calls.

i) Chmod ii) Chown.

c) State the two modes in which the line discipline operates.

d) Define inode.

e) State the algorithms that are executed on allocation of incore inode and on release of incore inode.

f) Explain following shell commands -

i) WC ii) IS.

g) Define "Working set of process".

h) What is use of wait ( ) system call?

i) State the two types of page fault the system can incur.

j) What is real and effective user ID?

Q2) Attempt any four of the following : **[4 x 4 = 16]**

a) Explain working of open system call with an example.

b) Write a shell script to check whether given number is palindrome or not.

c) Differentiate between 'named pipe' and 'unnamed pipe'.

d) What is super block? What are the contents of super block?

e) Describe "Fork Swap".

P.T.O.

Q3) Attempt any four of the following : **[4 x 4 = 16]**

a) Explain concept of Generic inode.

b) What are C lists? Describe operations performed on C lists?

c) Write a short note on 'Page stealer process'.

d) Write a shell program for finding factorial of a number.

e) Describe the characteristics of UNIX file system.

Q4) Attempt any four of the following : **[4 x 4 = 16]**

a) Explain how the kernel maintains the free space for the swap device.

b) A process wants to access byte offset 9000 in a file. Find the block number and byte offset in that block in a file system with 1K bytes per block.

c) Write the algorithm for converting path name to inode.

d) "A buffer can be on hash queue and on free list simultaneously". Justify whether True or False.

e) Explain architecture of UNIX System.

Q5) Attempt any four of the following : **[4 x 4 = 16]**

a) Explain how kernel manages list of free inodes in super block.

b) "If the mknod call is creating a directory node, the node will exist after the system call completes but its contents will be in the wrong format". Justify whether True or False.

c) Write algorithm for mounting a file system.

d) Explain following shell commands.

i) Cat ii) Grep.

e) Write an algorithm for protection fault handler.

Total No. of Questions : 5] **[Total No. of Pages : 3**

P897

[3635] - 405

M.Sc. Tech.

COMPUTER

Industrial Mathematics with Computer Applications

MIM - 405 : Design and Analysis of Algorithms - II

(Sem. - IV)

Time : 3 Hours] ***[Max. Marks : 80***

Instructions to the candidates :

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

Q1) Attempt any Eight of the following : **[8 x 2 = 16]**

a) What is a comparator? What is a comparison network?

b) When is a PRAM algorithm said to be work efficient?

c) Define rank of a matrix. Which is the maximum rank n x n matrix and which is the minimum rank n x n matrix?

d) What is complex n^{th} root of unity? What is the principal n^{th} root of unity?

e) State and prove cancellation lemma.

f) What is a digital signature?

g) Prove that for all integers a and b and any nonnegative integer n, $gcd(an, bn) = n\ gcd(a, b)$.

h) What is a valid shift? What is a string matching algorithm?

i) Define polynomial time reducibility and reduction algorithm.

j) What is a bounding box?

Q2) a) Attempt any one of the following : **[1 x 6 = 6]**

i) Let n be an exact power of 2. Show how to construct an n-input, n - output comparison network of depth log n in which the top output always carries the minimum input value and the bottom wire always carries the maximum input value.

ii) Explain how sorting network can be constructed using merger networks. Show that the depth of sorter $[n]$ is $O(\log^2 n)$.

b) Attempt any two of the following : **[2 x 5 = 10]**

i) Explain CRCW algorithm for finding maximum in an array. Is it work efficient.

P.T.O.

ii) Explain how EREW algorithm can be used to solve prefix computation problem. Show that it requires O(log n) time.

iii) Give two ways of representing polynomials and explain how one can convert from one form to another.

Q3) a) Attempt any one of the following : **[1 x 6 = 6]**

i) Use strassen's algorithm to compute the matrix product of following matrices giving each computation step

$$A=\begin{bmatrix}1 & 3\\ 2 & 7\end{bmatrix} \quad B=\begin{bmatrix}6 & 2\\ -5 & -4\end{bmatrix}$$

ii) Explain the significance of Bit reverse copy operation in iterative FFT. Give the bit-reverse copy algorithm and apply the same to the input vector (2, –3, 4, 0, 5, 7, 6, 2).

b) Attempt any two of the following : **[2 x 5 = 10]**

i) Solve the equation by using an LUP decomposition.

$$\begin{bmatrix}1 & 5 & 4\\ 2 & 0 & 3\\ 5 & 8 & 2\end{bmatrix}\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}=\begin{bmatrix}12\\ 9\\ 5\end{bmatrix}$$

ii) Explain the modular exponentiation algorithm.

iii) What is a Discrete Fourier transform of coefficient vector ($a_0, a_1, \ldots\ldots\ldots\ldots a_n$). Explain the method and algorithmic design strategy used to compute DFT.

Q4) a) Attempt any one of the following : **[1 x 6 = 6]**

i) What is a spurious hit? Explain Rabin Karp matcher algorithm. Working modulo 11, how many spurious hits does the Rabin-Karp matcher encounter in the text T = 8193724679 when looking for pattern 24?

ii) Private key encryption system is efficient but becomes insecure if key is used more than once while public key encryption system is secure but inefficient. How can you get best of both?

b) Attempt any two of the following **[2 x 5 =10]**

i) Write the algorithm to compute prefix function π and compute π for pattern p = *ababaaba* over the alphabet $\{a, b\}$.

ii) Give modular equation solver algorithm and solve the equation $21x = 14 \bmod(56)$.

iii) Write extended Euclid algorithm that returns a triplet for arbitrary integer. Trace the values (d, x, y) obtained by the invocation to extended Euclid (899, 493).

Q5) a) Attempt any one of the following : **[1 x 6 = 6]**

i) Explain circuit satisfiability problem and prove that circuit satisfiability problem belongs to NP class.

ii) What is TSP problem? What is triangle inequality for TSP problem? Prove that there is a 2-approximation algorithm for TSP problem with triangle inequality.

b) Attempt any two of the following : **[2 x 5 = 10]**

i) Explain the algorithm to find whether the given pair of lines intersect or not.

ii) Define NP-complete class. Show that any NP- complete problem is polynomial time solvable iff P = NP.

iii) Give approximate vertex cover algorithm. Show that approximate vertex cover has a ratio bound of 2.