Total No. of Questions : 5]

SEAT No. : ____

P622

[Total No. of Pages : 3

[4341] - 101

M.Sc. Tech. (Semester - I)

MATHEMATICS

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 101 : Real Analysis

(2008 Pattern)

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

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Unless specified,*** $\mathbf{R}^n$ ***is assumed to have usual metric for all*** $n \geq 1$.

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

a) For $x \in R$ and $y \in R$, define $d(x, y) = |x^2 - y^2|$. Determine if $d(x, y)$ is a metric or not.

b) Is $[0, 5] \cup [7, 8]$ a compact subset of R? Justify.

c) Give an example of a proper dense subset of R^2.

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

e) Let f be a function defined on (a, b). Define discontinuity of the first kind.

f) Find the radius of convergence of the following power series : $\sum_{n=1}^{\infty} z^n$.

g) State the Fundamental Theorem of calculus.

h) Show that the series $\sum_{n=2}^{\infty} \frac{1}{n (\log n)^3}$ converges.

i) Construct a bounded set of real numbers with exactly two limit points.

j) Let $f : [1, 2] \to R$ where $f(x) = e^x + x^2$. Is $f(x)$ uniformly continuous on [1, 2]? Justify.

P.T.O

Q2) a) Attempt <u>any one</u> of the following: **[1 × 6 = 6]**

i) Let X be a metric space. Define neighborhood of a point $p \in X$. Show that every neighborhood is an open set.

ii) Prove that for any collection $\{G_\alpha\}$ of open sets, $\cup_\alpha G_\alpha$ is open.

b) Attempt <u>any two</u> of the following: **[2 × 5 = 10]**

i) Prove that if $p > 0$, then $\lim_{n\to\infty} \sqrt[n]{p} = 1$.

ii) If X is a metric space and $E \subseteq X$, then prove that $E = \overline{E}$ if and only if E is closed.

iii) If $\{P_n\}$ is a sequence in a compact metric space X, then prove that some subsequence of $\{P_n\}$ converges to a point of X.

Q3) a) Attempt <u>any one</u> of the following: **[1 × 6 = 6]**

i) Let $\sum_{n=1}^{\infty} a_n$ be a series of non-zero real numbers. If $\lim_{n\to\infty} \sup \left|\frac{a_{n+1}}{a_n}\right| < 1$,

then show that the series $\sum_{n=1}^{\infty} a_n$ converges.

ii) If $\overline{E}$ is the closure of a set E in a metric space X, then prove that diam $\overline{E}$ = diam E.

b) Attempt <u>any two</u> of the following: **[2 × 5 = 10]**

i) Show that if a series $\sum_{n=1}^{\infty} a_n$ converges absolutely, then $\sum_{n=1}^{\infty} a_n$ converges.

ii) Let $\{S_n\}$ be a monotonic sequence which is bounded. Then prove that $\{S_n\}$ converges.

iii) Let *f* be a continuous real valued function on a metric space X and let $M = \sup_{x\in X} f(x)$. Prove that there exists a point $p \in X$ such that $f(p) = M$

Q4) a) Attempt <u>any one</u> of the following: **[1 × 6 = 6]**

i) Suppose *f* is a continuous mapping of a compact metric space X into a metric space Y. Then prove that *f*(X) is compact.

ii) If *f* is a continuous mapping of a metric space X into a metric space Y, and if E is a connected subset of X, then prove that *f*(E) is connected.

b) Attempt any two of the following: **[2 × 5 = 10]**

i) Let $f : \mathrm{R} \to \mathrm{R}$ be defined as $f(x) = \begin{cases} x^2 \sin\frac{1}{x} & if\ (x \neq 0) \\ 0 & if\ (x = 0) \end{cases}$.

Discuss the differentiability of f at every point $x \in \mathrm{R}$.

ii) Let $f_n(x) = \frac{x^2}{(1+x^2)^n}$ where $x \in \mathrm{R}$ and $n \in \mathrm{N} \cup \{0\}$.

Find $f(x) = \sum_{n=0}^{\infty} f_n(x)$. Discuss the continuity of $f(x)$.

iii) Let $\{S_n\}$ be a sequence in a metric space X. Prove that if $\{S_n\}$ converges, then $\{S_n\}$ is bounded.

Q5) a) Attempt any one of the following: **[1 × 6 = 6]**

i) Prove that $f \in \mathrm{R}(\alpha)$ on $[a\ b]$ if and only if for every $\in > 0$ there exists a partition P such that $\mathrm{U}(\mathrm{p}, f, \alpha) - \mathrm{L}(\mathrm{p}, f, \alpha) < \in$.

ii) Prove that the sequence of functions $\{f_n\}$, defined on E, converges uniformly on E if and only if for every $\in > 0$ there exists an integer N such that $m \geq \mathrm{N}$, $n \geq \mathrm{N}$, $x \in \mathrm{E}$ implies

$|f_n(x) - f_m(x)| \leq \in$.

b) Attempt any two of the following: **[2 × 5 = 10]**

i) Let $S_{m,n} = \frac{m}{m+n}$ where $m, n \in \mathrm{N}$.

Find $\lim_{n\to\infty} \lim_{m\to\infty} S_{m,n}$ and $\lim_{m\to\infty} \lim_{n\to\infty} S_{m,n}$.

ii) Discuss the convergence of the series $\sum_{n=1}^{\infty} \frac{x^n}{n}$, $x \in \mathrm{R}$, $x > 0$.

iii) If P* is a refinement of P, then prove that $\mathrm{U}(p^*, f, \alpha) \leq \mathrm{U}(p, f, \alpha)$.

❄❄❄

Total No. of Questions : 5]

SEAT No. :

P623

[Total No. of Pages : 3

[4341] - 102

M.Sc. Tech. (Semester - I)

MATHEMATICS

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 102 : Algebra - I

(2008 Pattern)

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) If order of every element (other than identity) of a group G is 2, show that G is an abelian group.

b) State Lagrange's theorem.

c) Show that there is no $\sigma \in S_8$ such that $\sigma(1, 2, 3)\ \sigma^{-1} = (4, 5)\ (6, 7,8)$.

d) Let G be a group and $g \in G$. Define $\phi : G \to G$ by $\phi(x) = gxg^{-1}$. Show that ϕ is a homomorphism ?

e) How many 3–cycles are there in A_4?

f) Give an example of an infinite integral domain having characteristic 2.

g) Let $I = < x^2 + 2 >$ in $C[x]$. Is I a maximal ideal? Justify!

h) Give an example of a non-zero prime ideal in a commutative ring R which is not a maximal ideal.

i) If F is a field and $\phi : F \to R$ is a non-zero ring homomorphism then show that ϕ is one-one.

j) Give an example of a ring R and a subring S such that R and S are commutative rings with identity but the identity elements in R and S are different.

P.T.O

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

i) Let H be a subgroup of a group G. Show that H is a normal subgroup of G if and only if every left coset of H in G is a right coset of H in G.

ii) Let $\phi : G \to G'$ be an onto homomorphism with kernel K. Let H' be a subgroup of G' and $H = \{x \in G | \phi(x) \in H'\}$. Then show that

A. H is a subgroup of G.

B. $K \subset H$.

C. If H' is a normal subgroup of G' then show that H is a normal subgroup of G.

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

i) If N and M are normal subgroups of a group G then show that NM is a normal subgroup of G.

ii) If G is a group such that $(ab)^n = a^n b^n$ for three consecutive integers n and for all $a, b \in G$, show that G is an abelian group.

iii) If G has no nontrivial subgroups, show that G must be finite of prime order.

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

i) Prove that every permutation is a product of transpositions.

ii) Let G be a finite group and $a \in G$. Prove that the number of elements conjugate to a in G is the index of the normalizer of a in G.

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

i) Show that a group of order 36 always has a normal subgroup.

ii) Prove that if a normal subgroup of A_n contains a 3-cycle then it must be all of A_n.

iii) Prove that every group of order p^n, p a prime and n a positive integer has a non-trivial centre.

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

i) Let R be a commutative ring with unit element. Show that an ideal I is a prime ideal if and only if R/I is an integral domain.

ii) Let R be a commutative ring with unit element whose only ideals are (0) and R itself. Then show that R is a field.

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

i) Let R be a commutative ring with identity and I be an ideal of R. Let $J = \{x \in R | x^n \in I$ for some positive integer $n\}$. Show that J is an ideal of R.

ii) Let R be a ring such that $x^2 = x$ for every $x \in R$. Prove that R is a commutative ring.

iii) Let $R = \{a + ib | a,b \in Z\}$ be subring of C and

$$I = \{a + ib | a,b \in Z; 3 \text{ divides } a \text{ as well as } b\}.$$

Show that I is an ideal of R and R/I is a field having 9 elements.

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

i) Let F be a field. Show that F[x] is a Euclidean ring.

ii) State and prove the Eisenstein's irreducibility criterion.

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

i) If R is a Euclidean ring then show that every ideal of R is principal.

ii) Find the greatest common divisor of $3x^2 + 1$ and $x^6 + x^4 + x + 1$ over Q, the field of rational mumbers.

iii) Let R be a commutative ring with identity element. Show that the units in R form an abelian group. Find all the units in R[x].

❄❄❄

Total No. of Questions : 5]

SEAT No. : ____

P624

[Total No. of Pages : 3

[4341] - 103
M.Sc. (Tech)
MATHEMATICS
Industrial Mathematics With Computer Applications
MIM - 103 : Discrete Mathematical Structures - 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 : **[2 × 8 = 16]**

a) Draw Hasse diagram for
D15 = {1, 3, 5, 15} where a $\leq$ b if f a/b.

b) Write truth table of $(\sim p \rightarrow q) \vee (p \wedge q)$.

c) Show that if any five numbers from 1 to 8 are chosen then two of them will add to?

d) State principle of Inclusion and Exchusion.

e) Define monoid. Give one example.

f) Define modular lastice.

g) Define valid argument.

h) Show that $(p \wedge q) \rightarrow (p \vee q)$ is a tantology.

i) Write down contrepositive and inverse of :- If sachim will get 'A' grade then he will get new bike.

j) Define "Join" in SQL statements.

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

a) Explain different types of database system ussers.

b) Explain various steps used to create and use cursors in PL/SQL block statements.

c) Write a short note on : functional dependency.

d) Explain concept of Aggregation.

e) Explain differences between file processing system & a DBMS.

P.T.O.

Q3) a) Attempt any two of the following : **[10]**

i) 'ABC Power corporation' has three types of plants like steam based, Nuclear based, hydro based. Each plant has energy in pressure form, radiation form, flow form respectively. Nuclear based plant has Technician, Engineer and scientist wherease hydrobased plant has engineer, techinician only. Both nuclear based and hydrobased plants are situated in the same location.

1) Identify all entities.
2) Identify Relations.
3) Draw an E-R diagram.

ii) A reputed general hospital has decided to computarize their operations. In the hospital many doctors are working. Personal Information of doctors are maintained to get them fixed salary permonth. The patients are admitled to the hospital into the room. They are treated by various doctors. Some times patients performs certain pathological tests which corried out into the labls.

1) Identify all entities.
2) Identify all relations.
3) Draw an E-R diagram.

iii) Give different symbols used in E-R diagram.

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

i) Consider following database

Employee (eno, ename, dno)

Project (Pno, Pname, Control, dept)

Employee and project are related with many-to many relationship having no.of hours as descriptive attribute

Write relational algebra gueries for the following.

1) List the names of employees working on both 'Finance' & 'Sales" Project.
2) List the names of project controlled by department = 5.

ii) Consider following database.

department (dno, dname, lacation)

employee (eno, ename, designation)

project (projno, projname, status)

departments employee are related s 1-to-may project and employee are related as 1-to-many.

Write relational algebra gueries for the following

1) List all the employees of 'inventory' department of 'Pune' Location.
2) Give the name of employees who are working on 'LIC' project.

Q4) a) Attempt <u>any eight</u> of the following : **[8]**

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

ii) What is normalization? Explain in detail 1NF, 2NF, 3NF and BCNF forms of normalization.

iii) Write a short note on Data Independence.

iv) Write any four aggregate functions which can be used to solve SQL queries, with example.

b) Attempt <u>any two</u> of the following : **[8]**

i) Define the following

1) An Identifying relationship.

2) Data defination language.

3) Primary key.

4) Schema.

iii) What is lossless join decomposition? Explain its importance.

iv) Write the differences between

1) Single attribute and multivalued attribute.

2) Simple attribute and composite attribute.

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

a) Consider the relation R (A, B, C, D, G, H, I) and set of FD'S defined on F as

$\{ A \rightarrow B, A \rightarrow C, CG \rightarrow H, CG \rightarrow I, B \rightarrow H\}$

Compute closare of F i.e. F^+.

b) Consider following database.

parts (Partno, name, quanitity, Price)

supplier (sno, sname, city)

The relation between parts and supplier is may-to-many

Sove following SQL queries.

1) List the names of suppliers supplying part no = 3 with price less than 5000.

2) List the names of suppliers from city, where names starts with 'P'.

c) Explain Generalization and Specialization concept in detail with suitable examples.

d) Write a short note on typle relational calculus.

e) Explain various relational algebra operators with suitable examples.

Total No. of Questions : 5]

SEAT No. :

P625

[Total No. of Pages : 4

[4341] - 104

M.Sc. Tech. (Semester - I)

COMPUTER SCIENCE

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 104 : 'C' Programming

(2008 Pattern)

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

Instructions to the candidates:-

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

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

a) Explain any 2 numeric data types used in programming.

b) Explain the use of directive : # include.

c) State the differences between compiler and interpreter.

d) Define array.

e) Define the structure for :

Employee (Eno, Ename, Esalary).

f) Write a built in function to open the file in read mode.

g) List out various application areas of C programming.

h) How pointers are declared. Explain with example.

i) What is the use of malloc ( ) function.

j) Write the output of :

```
void main ( )
{        char ch = 'A'; int i = 2;
  printf ("%c %c %c", ch, ++ch + i, ch);
}
```

P.T.O.

Q2) Attempt <u>any two</u> of the following : **[16]**

a) Write a c program to print the following pattern. Accept 'n' i.e. number of lines from the user.

A

A B

A B C

Here, n = 3

b) Write a menu driven program to perform following tasks on a string. Accept the string from the user.

Menu : i) Length - Find out length of the string

ii) Reverse - Print the reverse of a string

iii) Uppercase - Convert the string to uppercase

iv) Exit - Quit from program.

c) Write a program to accept a four digit number using command line argument.

Perform the digit by digit addition of the number till it gets to single digit number.

Ex : i/p : 2345

o/p : 5

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

a) Write a c program to accept 'n' integer array elements from the user. Print the array in reverse order.

b) Write a program to print the Fibonacci series using recursion.

c) Write a note on high level languages.

d) Explain different logical operators with example.

e) What is a function? Explain advantages of a function.

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

a) State and explain the use of return statement.

b) What is program development life cycle.

c) Write different types of files.

d) Write different standard library functions to accept a string from the user.

Write the O/P for the following (e - i)

e)
```
main ( )
{   int i = 2 ;
    printf (“%d  %d  %d”, i + = 2, ++i, i);
}
```

f)
```
main ( )
{   int x = 1;
   switch (x)
     { case 0 : x = 1;
       case 1 : x = 3;
       case 2 : x + = 4;
       case 3 : x = 2;
       default : x + = 2;
       }
         printf (“%d” , x);
}
```

g)
```
main ( )
{  char ch = ‘A’;
   for ( i = 0; i<5; i++)
    { printf (“%c”, ch++);
}
 printf (“ \ n”);
}
```

h)
```
main ( )
{  int  i = 5;
   while (i)
    { i – – ;
      if (i = = 3)
            break ;
      printf (“%d”, i);
    }
}
```

i)
```
main ( )
{ int C [ ] = {1, 2, 3, 4, 5, 6, 7, 8, 9, 0}
      int sum = 0;
      for (i = 0; i < 10; i++)
        {  if (c[i] %2 = = 0)
             sum = sum + C [ i ];
      }
      printf ("%d", sum);
}
```

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

a) Explain how pointers are passed to the function. Give example.

b) Write a note on unions.

c) Write a note on macro.

d) Write a program to generate the series of 'n' odd numbers. Accept 'n' from the user.

e) Write a program to accept 'n' elements from the user store them using pointers. Find out maximum of them. Accept 'n' from the user.

Total No. of Questions : 5]

SEAT No. :

P626

[Total No. of Pages : 2

[4341] - 105

M.Sc. Tech. (Semester - I)

Computer Science

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 105 : Elements of Information Technology

(2008 Pattern)

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 : operating system.

b) Explain different special characters in files.

c) Explain the concept of communication.

d) What is cache memory?

e) What is binary number system?

f) What is serial port for input devices?

g) Define protocol in computer networking.

h) What is Batch OS?

i) What is EBCDIC code?

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

a) Explain any four characteristics of computers.

b) Convert number 14 to a.hexadecimal, octal number.

c) What are different services provided by operating system?

d) Explain Von Neumann model of computer.

e) With example explain Dense Index.

P.T.O.

Q3) Attempt <u>any four</u> of the following. **[16]**

a) Explain multiprogramming OS.

b) What are fixed length and variable length records?

c) With suitable dig. explain the structure of computer.

d) Explain various secondary storage devices.

e) Define

i) Primary memory.

ii) Secondary memory.

Q4) Attempt <u>any four</u> of the following. **[16]**

a) What are different input devices? Explain working of keyboard.

b) Explain 3rd generation of computers.

c) Explain the features of distributed system.

d) What are different types of file organization?

e) What are different components of network?

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

a) In detail, explain different network topologies.

b) Explain the concept of information technology. What is www?

c) Define software. Explain different types of software in detail.

❄❄❄

Total No. of Questions : 5]

SEAT No. : ____

P627

[Total No. of Pages : 3

[4341] - 201

M. Tech. (Semester - II)

MATHEMATICS

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 201 : Real and Complex Analysis

(2008 Pattern)

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) If $f(x) = \begin{cases} 0 & if \quad x \quad is \quad irrational, \\ 1 & if \quad x \quad is \quad rational, \end{cases}$ then show that $R\int_a^{\bar{b}} f(x)\,dx = b - a$.

b) Show that outermeasure of the set of rational numbers in [0,1] is zero.

c) State Fata'is lemma.

d) Let f : [0, 2 π] $\longrightarrow$ R defined by $f(x) = \sin x$. Find f^+ and f^-.

e) Show that if E is a measurable set, then each translate E + y of E is also measurable.

f) Find the radius of convergence of the series $\sum_{n\geq 0} \frac{Z^{2n}}{(2n)!}$.

g) Show that u(x, y) = xy is harmonic in R^2 and find the conjugate harmonic function u(x, y) in R^2.

h) Evaluate $\int_\gamma xdz$, where γ is the straight line segment from 0 to 2 + 3i.

i) Discuss the singularities of the function $f(z) = \frac{1}{\cos(1/2)}$.

j) State Liouville's theorem.

P.T.O

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

i) Let A be any set, and E_1, ..., E_n, a finite sequence of disjoint measurable sets. Then show that

$$m^*\left(A \cap \left[\bigcup_{i=1}^{n} E_i\right]\right) = \sum_{i=1}^{n} m^*\left(A \cap E_i\right)$$

ii) Let *f* be a bounded function defined on [a, b]. If *f* is Riemann integrable on [a, b], then show that *f* is measurable. Further, show that

$$R\int_a^b f(x)\,dx = \int_a^b f(x)\,dx$$

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

i) Show that if E_1 and E_2 are measurable sets then show that $m(E_1 \cup E_2) = m(E_1) + m(E_2) - m(E_1 \cap E_2)$

ii) If *f* and *g* are bounded measurable functions defined on a set E of finite measure and a,b $\in$ R then show that

$$\int_E af + bg = a\int_E f + b\int_E g$$

iii) Let *f* be a non-negative measurable function. If $f = 0$ a.e. then show that $\int_E f = 0$. Also, show that if $\int_E f = 0$ then f = 0 a.e. in E. (where E is a measurable set).

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

i) Let $\langle f_n \rangle$ be an increasing sequence of non negative measurable functions, and let $f = \lim f_n$ a.e. . Then show that $\int f = \lim \int f_n$

ii) State and prove Lebesgue Convergence theorem.

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

i) Let f be a non negative function which is integrable over a set E. Then show that given $\in > 0$ there is a $\delta > 0$ such that for every measurable set $A \subset E$ with m A < δ, we have

$$\int_A f < \in$$

ii) Let $f : [0, 1] \to R$ defined by $f(x) = x^3 + \sin x - e^x$. Show that *f* is a measurable function. Find $\int_0^1 f$.

iii) Give an example of a non-measurable set.

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

i) Let γ be a closed curve and a ∉ γ. Show that

$$\frac{1}{2\pi i}\int_{\gamma}\frac{dz}{z-a} \text{ is an integer.}$$

ii) State and prove Morera's theorem.

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

i) Find Taylor series expansion of $f(z)=\frac{1}{1-z-z^2}$ about 0.

ii) If *f* is entire and Re *f(z)* is bounded as $R\to\infty$, then show that *f* is constant.

iii) Show that every Möbius transformation is a combination of translation, rotation, magnification and inversion transformations.

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

i) State Cauchy's residue theorem. Further, evaluate

$$I=\frac{1}{2\Pi i}\int_{c}\frac{f^{1}(z)}{f(z)}dz, \text{where } C=\{z:|z-1-i|=2\}$$

$$\text{and } f(z)=\frac{z-2}{z(z-1)}$$

ii) State and prove Liouville's theorem.

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

i) Let $f(z)=\frac{1}{(z^3-1)(z+1)^2}$. Find Res [*f(z)*; -1] and

Res [*f(z)*, 1], Res [*f(z)*; *w*] and Res [*f(z)*; w^2],

where $w=\frac{-1+i\sqrt{3}}{2}$

ii) Let $f(z)=\text{Log}\left(\frac{z^n}{z^{n-1}}\right), |z|>$ where *n* is a fixed positive integer. Find the Laurent series expansion for *f*.

iii) Prove that the four distinct points z, z_1, z_2, z_3 all lie on a circle or on a line if and only if their cross ratio (z, z_1, z_2, z_3) is a real number.

❄❄❄

Total No. of Questions : 5]

SEAT No. :

P628

[Total No. of Pages : 3

[4341] - 202

M.Sc. Tech. (Semester - II)

MATHEMATICS

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 202 : Algebra - II

(2008 Pattern)

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 × 2 = 16]**

a) State true or false : Any set containing O is linearly dependent.

b) If a linear transformation

$T : R^2 \to R^4$ has nullity 1. Find rank of T.

c) Define field extension and degree of extension.

d) Find the splitting field of $x^3 - 1$ over Q.

e) State Eisenstein's criterion.

f) Find the eigen values and corresponding eigen vectors of the matrix.

$$A = \begin{bmatrix} 1 & 0 \\ 0 & 4 \end{bmatrix}.$$

g) Construct a field containing 4 elements.

h) Give an example of an irreducible polynomial of degree 3 over Z/3Z. Justify.

i) Consider $V_1 = (2, 3)$ and $V_2 = (3, -4) \in R^2$ with usual inner product. Compute angle between V_1 and V_2.

j) Show that set $S = \{(2, -1, 4)\ (3, 6, 2)\ (2, 10, -4)\}$ is linearly independent.

P.T.O

Q2) a) Attempt <u>any one</u> of the following: **[1 × 6 = 6]**

i) If V_1, V_2, ----------, V_r are vectors in a vector space V then prove that set W of all linear combinations of V_1, -------, V_r is a subspace of V. Also prove that W is the smallest subspace of V that contains V_1, --------, V_r.

ii) Let S = $\{V_1, V_2, \text{------}, V_r\}$ be a set of vectors in R^n. If r > n prove that if S is linearly dependent.

b) Attempt <u>any two</u> of the following: **[2 × 5 = 10]**

i) Find a matrix P, that diagonalizes the matrix A where

$$A = \begin{bmatrix} 5 & 1 & 1 \\ 1 & 5 & -1 \\ 1 & -1 & 5 \end{bmatrix}$$

ii) Let T : $R^3 \rightarrow R^4$ be a linear transformation which is multiplication by the matrix

$$A = \begin{bmatrix} 1 & -2 & 4 \\ -1 & 0 & 3 \\ -3 & 4 & -5 \\ 0 & 1 & 0 \end{bmatrix}$$

Find a basis for range of T and hence find rank and nullity of T.

iii) Consider the vector space R^3. Let $x = (x_1, x_2, x_3)$ and $y = (y_1, y_2, y_3)$ be any two vectors in R^3. Show that the following defines an inner product on R^3.

$\langle x, y \rangle = .2x_1y_1 + x_2y_2 + 4x_3y_3$.

Q3) a) Attempt <u>any one</u> of the following: **[1 × 6 = 6]**

i) Suppose T : V → W is a linear transformation. Prove that Ker (T) is a subspace of V and range of T is sub space of W.

ii) If u and v are any two vectors in an inner product space. Prove that

$\langle u,v \rangle^2 \leq \langle u, u \rangle \langle v, v \rangle$

b) Attempt <u>any two</u> of the following: **[2 × 5 = 10]**

i) Consider the Euclidean inner product space R^3. Transform the basis $\{u_1, u_2, u_3\}$ into an orthonormal basis using gram – schmidt process where $u_1 = (1, -1, 1)$, $u_2 = (2, 1, 0)$, $u_3 = (-1, -1, 1)$.

ii) Let B = $\{1 + x + x^2, -1 + x, 1 + 2x + x^2\}$ be a basis for the vector space P_2. Determine the co-ordinate vector of $P = 6 + x + 3x^2$ in P_2 relative to B. Hence write the co-ordinate matrix of P relative to B.

iii) If u and v are two vectors in an inner product space V then show that $< u, v >= \frac{1}{4} \| u + v \|^2 - \frac{1}{4} \| u - v \|^2$.

Q4) a) Attempt <u>any one</u> of the following: **[1 × 6 = 6]**

i) Prove that any finite extension is an algebraic extension. What about the converse? Justify your answer.

ii) Let F be a field having infinite number of elements. If K is a finite separable extension of F then prove that there is $\alpha \in K$ such that $K = F(\alpha)$.

b) Attempt <u>any two</u> of the following: **[2 × 5 = 10]**

i) Let P be a prime. Show that the splitting field of $x^P - 1 \in Q[x]$ is of degree P – 1 over Q.

ii) Give an example of in separable extension. Justify.

iii) Show that $f(x) = x^3 - 3x^2 + 3x - 3$ is an irreducible polynomial over Q.

Q5) a) Attempt <u>any one</u> of the following: **[1 × 6 = 6]**

i) If K/F and F/E are algebraic extensions then show that K/E is an algebraic extension.

ii) Let K be a field. Let G be the group of automorphisms of K. Define a fixed field of G. Prove that a fixed field of G is a subfield of K.

b) Attempt <u>any two</u> of the following: **[2 × 5 = 10]**

i) Show that K is a normal extension of F if and only if K is a splitting field for some polynomial over F.

ii) Find the Galo is group of $x^3 - 7$ over the field of rationals.

iii) Find subfield lattice diagram for $E = Q(\sqrt{2}, \sqrt{3}, \sqrt{5})$ over F = Q. Hence find degree of extension of field E over F.

❄❄❄

Total No. of Questions : 5]

SEAT No. : ____

P629

[Total No. of Pages : 4

[4341] - 203

M.Sc. Tech. (Semester - II)

MATHEMATICS

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 203 : Discrete Mathematical Structures - II

(2008 Pattern)

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

Instructions to the candidates:

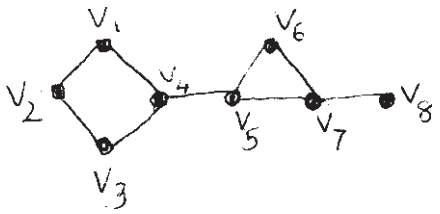
1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***

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

a) Draw a simple 3 regular graph on 6 vertices.

b) Draw all simple non isomorphic unlabelled graphs on 3 vertices.

c) Find all bridges of the following graph.

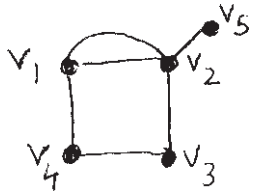


d) Find the edge connectivity of K_5.

e) Define bipartite graph.

f) Define asymmetric diagraphs.

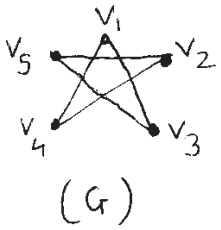
g) Draw the graph obtained by fusing the vertices V_2 and V_3 of the following graph.



h) When is a diagraph G said to be an arborescence?

P.T.O

i) Find the complement of the following graph G.



(G)

j) Is the chromatic number of any cycle with atleast 3 vertices two? Justify.

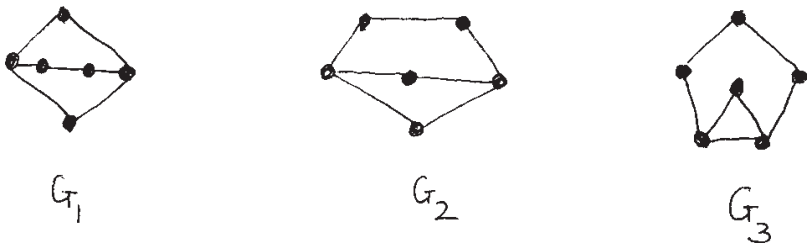
Q2) a) Attempt <u>any one</u> of the following: **[1 × 6 = 6]**

i) Prove that a connected graph G is an Euler graph if and only if it can be decomposed into circuits.

ii) Prove that a tree with n vertices has n – 1 edges.

b) Attempt <u>any two</u> of the following : **[2 × 5 = 10]**

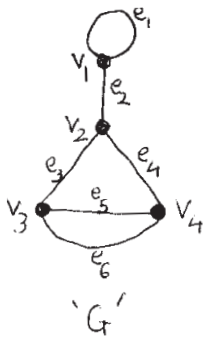
i) Find the isomorphic pair out of the three graphs shown below. Justify.



G_1 G_2 G_3

ii) Find the maximum and minimum height of a binary tree with 11 vertices. Draw the two trees.

iii) Write down the adjacency and incidence matrices for G where G is



'G'

Q3) a) Attempt <u>any one</u> of the following: **[1 × 6 = 6]**

i) Prove that every tree has either one or two centres.

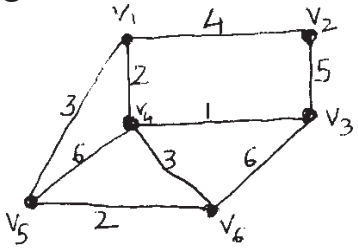
ii) Prove that a connected planar graph with n vertices and e edges has (e – n + 2) regions.

b) Attempt <u>any two</u> of the following : **[2 × 5 = 10]**

i) Prove that it is impossible to have a group of nine people at a party such that each one knows exactly five of the others in the group.

ii) Write a short note on the chinese postman problem.

iii) Find a shortest spanning tree for the following weighted graph using Kruskal's algorithm.



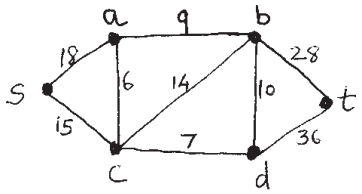
Q4) a) Attempt <u>any one</u> of the following: **[1 × 6 = 6]**

i) Prove that a simple graph with n vertices and k components can have atmost $\frac{(n-k)(n-k+1)}{2}$ edges.

ii) Explain depth first search (DFS) algorithm for a graph.

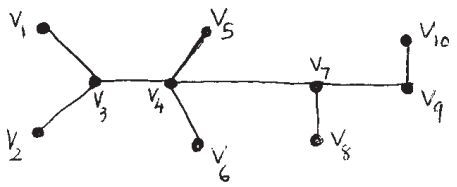
b) Attempt <u>any two</u> of the following : **[2 × 5 = 10]**

i) Using Dijkstra's algorithm, find the shortest path from 's' to 'd' in the following graph 'G'.



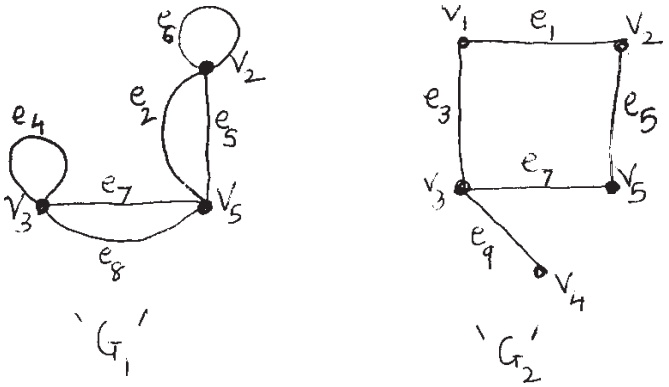
'G'

ii) Find the eccentricity of each vertex of the tree T given below. Hence, find its centre.



'T'

iii) Find $G_1 \cup G_2$ and $G_1 \cap G_2$ of the following graphs G_1 and G_2.



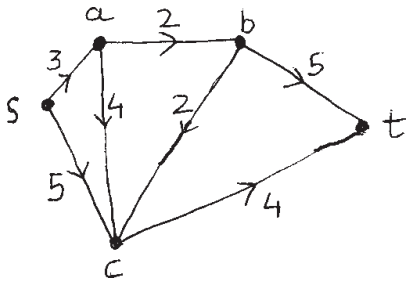
Q5) a) Attempt <u>any one</u> of the following: **[1 × 6 = 6]**

i) Explain simple sequential colouring algorithm for colouring a graph G.

ii) Prove that the complete graph of five vertices is nonplanar.

b) Attempt <u>any two</u> of the following : **[2 × 5 = 10]**

i) By using Ford Fulkerson algorithm, determine the maximum flow in the network given below.



ii) Let T be a binary tree with n vertices. Show that T has $\frac{n+1}{2}$ pendant vertices.

iii) Prove that in any simple connected planar graph with f regions, n vertices and e edges (e > 2), the following inequalities hold :

$e \geq \frac{3}{2} f$ and $e \leq 3n - 6$.

❄❄❄

Total No. of Questions : 5] **SEAT No. :**

P630 **[Total No. of Pages : 3**

[4341] - 204

M.Sc. Tech. (Semester - II)

COMPUTER SCIENCE

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 204 : Database Fundamentals

(2008 Pattern)

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) What is Referential integrity constraint? Explain.

b) State any two functions of DBA.

c) Define following :

i) Entity

ii) Candidate key.

d) How weak entity set is indicated in E-R diagram?

e) What is DBMS? Give two advantages of DBMS.

f) Explain groupby, having clause used in SQL.

g) What is difference between multivalued attribute and derived attribute? Explain with example.

h) Explain outer joins.

i) Define any two nested query operators.

j) Define "Join" in SQL statements.

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

a) Explain different types of database system users.

b) Explain various steps used to create and use cursors in PL/SQL block statements.

c) Write a short note on : functional dependency.

d) Explain concept of Aggregation.

e) Explain differences between file processing system & a DBMS.

P.T.O.

Q3) a) Attempt <u>any two</u> of the following : **[10]**

i) 'ABC Power corporation' has three types of plants like steam based, Nuclear based, hydro based. Each plant has energy in pressure form, radiation form, flow form respectively. Nuclear based plant has Technician, Engineer and scientist where are hydrobased plant has engineer, techinician only. Both nuclear based and hydrobased plants are situated in the same location.

1) Identify all entities.
2) Identify Relations.
3) Draw an E-R diagram.

ii) A reputed general hospital has decided to computerize their operations. In the hospital many doctors are working. Personal Information of doctors are maintained to get them fixed salary per month. The patients are admitted to the hospital into the room. They are treated by various doctors. Some times patients performs certain pathological tests which carried out into the labs.

1) Identify all entities.
2) Identify all relations.
3) Draw an E-R diagram.

iii) Give different symbols used in E-R diagram.

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

i) Consider following database

Employee (eno, ename, dno)

Project (Pno, Pname, Control_dept)

Employee and Project are related with many-to many relationship having no.of hours as descriptive attribute

Write relational algebra queries for the following.

1) List the names of employees working on both 'Finance' & 'Sales' Project.
2) List the names of project controlled by department = 5.

ii) Consider following database.

department (dno, dname, location)

employee (eno, ename, designation)

project (projno, projname, status)

department & employee are related as 1-to-many project and employee are related as 1-to-many.

Write relational algebra queries for the following

1) List all the employees of 'inventory' department of 'Pune' Location.
2) Give the name of employees who are working on 'LIC' project.

Q4) a) Attempt <u>any two</u> of the following : **[8]**

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

ii) What is normalization? Explain in detail 1NF, 2NF, 3NF and BCNF forms of normalization.

iii) Write a short note on Data Independence.

iv) Write any four aggregate functions which can be used to solve SQL queries, with example.

b) Attempt <u>any two</u> of the following : **[8]**

i) Define the following

1) An Identifying relationship.

2) Data definition language.

3) Primary key.

4) Schema.

ii) What is lossless join decomposition? Explain its importance.

iii) Write the differences between

1) Single attribute and multivalued attribute.

2) Simple attribute and composite attribute.

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

a) Consider the relation R (A, B, C, D, G, H, I) and set of FD'S defined on F as

$\{ A \rightarrow B, A \rightarrow C, CG \rightarrow H, CG \rightarrow I, B \rightarrow H\}$

Compute closure of F i.e. F^+.

b) Consider following database.

Parts (Partno, name, quantity, Price)

Supplier (Sno, Sname, city)

The relation between Parts and Supplier is many-to-many

Solve following SQL queries.

1) List the names of Suppliers supplying Part no = 3 with price less than 5000.

2) List the names of Suppliers from city, where names starts with 'P'.

c) Explain Generalization and Specialization concept in detail with suitable examples.

d) Write a short note on tuple relational calculus.

e) Explain various relational algebra operators with suitable examples.

Total No. of Questions : 5]

SEAT No. :

P631

[Total No. of Pages : 3

[4341] - 205

M.Sc. Tech. (Semester - II)

COMPUTER SCIENCE

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 205 : Data Structures Using 'C'

(2008 Pattern)

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

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***All questions carry equal marks.***

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

a) Define the terms : data type and abstract data type (ADT).

b) Consider the following stack operations: PUSH A, PUSH B, PUSH C, pop PUSH D, pop PUSH E. If next operation on the stack is pop, what will be the value of stack top element? Show the contents of stack.

c) Consider the two polynomials $P_1(x) = 2x^5 + x + 1$ and $P_2(x) = x^4 + 10x^3 + 3x^2 + 1$. How these polynomials are stored in the array terms.

d) What will be the output of APQ and DPQ, if the contents of queue are :

25, 4, 5, 26, 31, 9, 10, 15.

e) Represent the following array in terms of Binary tree.

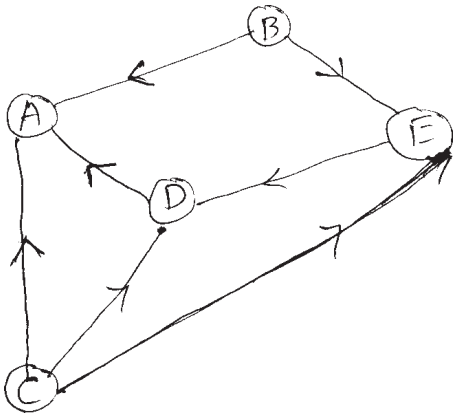
A	M	B		C	D		E	
0	1	2	3	4	5	6	7	8

f) Consider the following set of elements:

25, 37, 12, 48, 57, 33. Show the list of elements at the end of pass 1 using bubble sort method.

P.T.O.

g) Find out indegree, outdegree of the following graph.



h) Discuss the time complexity of linear search in average case.

i) What is Binary Search tree?

j) Define circular linked list. Also state its advantages.

Q2) Attempt <u>any two</u> of the following: **[2 × 8 = 16]**

a) Write a 'C' program to accept two sorted lists and print the merging of these two lists.

b) Write a 'C' program to create a binary tree and print its contents using inorder and preorder traversals.

c) Write a menu driven program using 'C' to implement all the operations of circular queue of size 5 elements.

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

a) Discuss the various posibilities while deleting a node from binary search tree.

b) Explain linear and non-linear data structures with suitable examples.

c) Evaluate the following postfix expression using stack. Also give the contents of stack. 654 ∗ 8 + ∗.

d) Write a note on array as ADT.

e) Write a function to delete last node of the singly linked list.

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

a) What is polish notation? Explain infix, postfix and prefix notations.

b) Write a note on FCFS CPU scheduling technique.

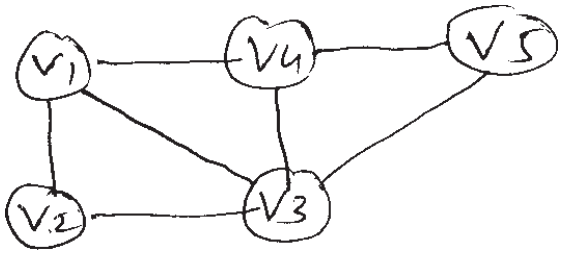
c) Compare the data structures : Stack and queue.

d) Write a function to implement recursive DFS.

e) Write a note on doubly linked list. Explain all cases to insert a node.

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

a) Convert the following graph into its adjacency list.



b) Write a note on merge sort.

c) Construct the binary search tree for the following set of elements.

MATHS, PHY, CHEM, BIO, GEO, ZOOLOGY, COMP, STAT, ELEC.

d) Write a note on DEQUEUE and its types.

e) What is queue? Write a function to remove (delete) an element from the queue.

❄❄❄

Total No. of Questions : 5]

SEAT No. : ____

P638

[Total No. of Pages : 2

[4341] - 402

M.Sc. Tech. (Semester - IV)

COMPUTER SCIENCE

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 402 : Computer Networks

(2008 Pattern)

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

Instructions to the candidates:-

1) ***Neat diagrams must be drawn wherever necessary.***
2) ***Figures to the right indicate full marks.***
3) ***All questions carry equal marks.***
4) ***All questions are compulsory.***

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

a) What is the purpose of transport layer?

b) Show the RZ and Differential Manchester encoding for the bit pattern 111001101.

c) List out various framing methods.

d) Give diagrammatic representation for BSS without AP and BSS with AP.

e) For the following class of IP address, how many bytes are into netid and hostid.

i) Class A ii) Class C

f) Explain the fields of UDP segments.

g) Discuss the role of UA and MTA used in SMTP protocol.

h) Give any four differences between OSI and TCP/IP network models.

i) Give the examples of any two guided media.

j) What is piggy backing? Give it's drawbacks.

P.T.O.

Q2) a) Attempt <u>any one</u> of the following : **[1 × 6 = 6]**

i) Describe the services of data link layer.

ii) Write a note on routing table for classful addressing.

b) Attempt <u>any two</u> of the following : **[2 × 5 = 10]**

i) Explain the sender and receiver side of stop-and-wait protocol.

ii) Write a note on remote bridges.

iii) What is line coding? Explain characteristic of line coding.

Q3) a) Attempt <u>any one</u> of the following : **[1 × 6 = 6]**

i) Compare virtual circuit and datagram.

ii) Write a note on classful addressing.

b) Attempt <u>any two</u> of the following : **[2 × 5 = 10]**

i) Explain transport service primitives.

ii) Draw the basic model of FTP and Explain.

iii) Write a note on piconet and scatternet.

Q4) a) Attempt <u>any one</u> of the following : **[1 × 6 = 6]**

i) Explain URG, ACK, PSH, RST, SYN and FIN flags of TCP segment header.

ii) Write a note on ICMP encapsulation.

b) Attempt <u>any two</u> of the following : **[2 × 5 = 10]**

i) Write a note on ARP.

ii) Explain non-persistent and persistent strategies.

iii) What is the remainder obtained by dividing $x^7 + x^5 + 1$ by generator polynomial $x^3 + 1$.

Q5) a) Attempt <u>any one</u> of the following : **[1 × 6 = 6]**

i) Write a note on multiplexing.

ii) Describe the steps in making remote procedure call.

b) Attempt <u>any two</u> of the following : **[2 × 5 = 10]**

i) Write a note on remote login used in TELNET.

ii) Write a note on PCM.

iii) Explain packet switching and circuit switching.

✪✡✪✡

Total No. of Questions : 5]

SEAT No. :

P639

[Total No. of Pages : 2

[4341] - 403

M.Sc. Tech. - II (Semester - IV)

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 403 : Web Technologies

(2008 Pattern)

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

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Draw neat diagrams whenever necessary.***

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

a) What are cookies? Where are they stored?
b) What are CELLSPACING & CELLPADDING attributes of <table> tag.
c) "Javascript is dynamically typed". Justify.
d) Explain chop & substr functions of PHP.
e) What is purpose of ` qq ´ operator in perl? Give suitable example.
f) What is output?

Var X = 3; document.write (X == "3");

g) What is server root & document root?
h) Write general form of element & entity declaration in XML.
i) What is use of ksort & asort function of PHP.
j) Write HTML tag to display text box which allows 30 characters to be displayed.

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

a) Differentiate between Java & Javascript.
b) What is IP Address & Domain Names? How IPv4 is different from IPv6.
c) What are character entities in HTML? Give any four entities with their use.
d) Give advantages of servlet over CGI.
e) What is CGI.pm module in perl? Explain with examples.

P.T.O.

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

a) What is XML schema? What are its advantages over DTD?

b) Give general form of HTTP response. Explain status line & status code of HTTP response.

c) Explain built-in list functions split & ๆ with example in perl.

d) Write program in perl for reading file without file handle & print it on console.

e) How can the value of a form element be accessed by PHP script? Give examples.

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

a) Explain XSLT processing with suitable example.

b) Create HTML page that divides browser window in two vertical sections. In left frame index-html is loaded which contains links 'MCS' & 'MCA' each of which when clicked respective file should open in right frame.

c) Explain object creation in javascript with example. Write statement to delete a property of an object.

d) How PHP array is different from array in perl. Give example of for each loop to process array in PHP.

e) Explain concept of ordered and unordered list with suitable example in HTML.

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

a) Create XML document for storing student details as RollNo., Name, age, Address.

b) What is JSP? What are its advantages over servlet?

c) Write PHP script to print square, squareroot & cube of elements from 1 to 10 with HTML table.

d) Explain various tags in HTML for table creation.

e) List primitive types in PHP. Explain string type in detail.

❖❖❖❖

Total No. of Questions : 5]

SEAT No. : ____

P642

[Total No. of Pages : 4

[4341] - 502

M.Sc. Tech. (Semester - V)

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 502 : Numerical and Statistical Methods

(2008 Pattern)

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: **[8 × 2 = 16]**

a) Write the classical definition of probability.

b) Four cards are drawn at random from a well shuffled pack of 52 cards. Find the probability that, two cards are red and two are black.

c) Define conditional probability P(A/B).

d) A and B are two events defined on a sample space such that $P(A) = \frac{1}{4}$, $P(B/A) = \frac{1}{2}$. Find $P(A \cap B)$.

e) Let A and B be two events defined on sample space. If $P(A) = \frac{1}{3}$, $P(B) = \frac{1}{4}$, $P(A \cap B) = \frac{1}{6}$, Find $P(A' \cap B')$.

f) Define probability distribution of a discrete random variable X.

g) Find the parameters of the distribution of X, if X follows Binomial distribution with mean = 10 and variance = 5.

h) State the pmf of Poisson distribution with parameter λ.

i) Let $X \rightarrow N(2,1)$. Find $P((X-2) \geq 0)$.

j) State any two properties of correlation coefficient.

k) Given $r_{13} = 0.6$, $r_{12} = 0.4$, $r_{23} = 0.5$, calculate the partial correlation coefficient $r_{12.3}$.

P.T.O

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

a) The letters of the word 'SEMINAR' are arranged at random. Find the probability that

i) The vowels occupy the even places.

ii) The words formed start with S and end with R.

b) A discrete random variable X has the following probability distribution.

X	–2	–1	0	1	2	3
P(X=X)	0.1	K	0.2	2k	0.3	k

i) Determine the value of value of k.

ii) Find the mean of X.

c) Define cumulative probability distribution of a discrete random variable X. Also state its important properties.

d) State the probability mass function of Binomial distribution with parameters n and p. State its mean and variance. Also state the additive property of Binomial distribution.

e) The probability of no misprints in a page of a book is 0.15. Find the probability that,

i) a page selected at random will have 2 misprints?

ii) a page selected at random will have at most 2 misprints?

Q3) Attempt any four of the following. **[4 × 4 = 16]**

a) Define the following for a continuous random variable X :

i) probability distribution of X.

ii) mean and variance of X.

b) Suppose a continuous r.v. X has pdf

$f(x) = x^2/3, \quad -1 \le x \le 2$

$= 0 \quad$ otherwise

If $A = \{x/x \ge 0\}$, $B = \{x/-1/2 \le x \le ½\}$, find $P(A \cap B)$ and $P(A \cup B)$.

c) Write the probability density function of Exponential distribution with mean 2. State its variance. Also find P(X>2).

d) Let X be a continuous random variable with Uniform distribution over (2, 10).

i) Write the probability density function of X.

ii) Find the distribution function of X.

e) For a standard normal variable X, find k such that

i) $P(-k < X < k) = 0.95$

ii) $P(0 < X < k) = 0.442$

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

a) Explain the following terms with suitable examples :

i) Positive correlation

ii) Negativ correlation

b) The table below gives the data related to sales (in Rs crores) and advertising expenses (in Rs lakhs).

Sales (X)	14	16	18	20	24	30	32
Advertising expenses	52	62	65	70	76	80	78

Estimate the sale when the advertising expenses are 100 lakhs.

c) Explain the method of fitting line of regression of Y on X.

d) The average life of a certain brand of electric bulbs has standard deviation of 125 hrs. A random sample of 100 bulbs gives average life of 1025 hrs. Does it support the company's claim of average life of 1000 hours at 1% level of significance?

e) The theory predicts that the proportion of beans in the 4 groups A, B, C and D should be 9:3:3:1. In an experiment among 1600 beans, the numbers in the four groups were 882, 313, 287 and 118. Do the experimental results support theory?

(use $\alpha = 0.05$)

Q5) Attempt any four of the following: **[4 × 4 = 16]**

a) Two random variable X and Y have the regression equations :

$3X + 2Y - 26 = 0$, $6X + Y - 31 = 0$

Find the mean values and the correlation coefficient between X and Y. If the variance of X is 25, find the standard deviation of Y.

b) Define the following for a trivariate data:

i) Multiple Correlation Coefficient $R_{1.23}$.

ii) Partial Correlation Coefficient $r_{12.3}$.

c) The editor of a statistics journal wishes to use the sample data calculations provided below to determine regression equation that predicts the total typing hours (X_2) for article drafts. As independent variables, she used the number of words in the draft (X_1) (expressed in ten thousands) and an index(X_3) for level of difficulty on the scale from 1 to 5.

$n = 25$, $\overline{X_1} = 4$ $\overline{X_2} = 8$ $\overline{X_3} = 3$

$\sigma_1^2 = 9$ $\sigma_2^2 = 81$ $\sigma_3^2 = 4$

$r_{12} = 0.3$ $r_{13} = -0.7$ $r_{23} = 0.4$

Determine the regression equation for the regression plane of X_2 on X_1 and X_3.

d) Explain the procedure of testing $H_0 : P = P_0$ against $H_1 : P \neq P_0$ for a sample of size n ($n \geq 30$) at α% level of significance.

e) Complete the following ANOVA table :

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F-Ratio
Treatment	2	36	?	?
Error	9	?	?	
Total	11	72		

❄❄❄

Total No. of Questions : 5]

SEAT No. : ____

P643

[Total No. of Pages : 2

[4341] - 503

M.Sc. Tech. (Semester - V)

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 503 : Digital Image Processing

(2008 Pattern)

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 × 2 = 16]**

a) 'Image resulting from poor illumination cannot be segmented easily'- Comment.

b) Justify the statement : 'Laplacian is better than gradient for detection of edges'.

c) What are the different reasons for poor contrast?

d) State the difference between spatial resolution and intensity resolution.

e) Justify the statement : 'All image compression techniques are not invertible'.

f) What is digital image?

g) 'Image cannot be obtained if histogram is given' - Comment.

h) Justify the statement : 'Quality of picture depends on the number of pixels and the gray levels that represent the picture'.

i) Define saturation in digital image.

j) If all the pixels in an image are shuffled, will there be any change in the histogram.

P.T.O.

Q2) Answer any four of the following : **[4 × 4 = 16]**

a) Explain with example the difference between correlation and convolution.

b) Differentiate between image enhancement and image restoration.

c) Discuss the smoothing operation in frequency domain.

d) Explain the RGB model of the color image.

e) How to filter an image in the frequency domain? Give its flowchart.

Q3) Answer any four of the following : **[4 × 4 = 16]**

a) Why do we process images? Explain with suitable examples.

b) Differentiate between Image processing and Image analysis.

c) Describe the general compression system model.

d) What are the elements of digital image processing system? Explain any one in detail.

e) Explain any one method of image acquisition.

Q4) Answer any four of the following: **[4 × 4 = 16]**

a) What do you understand by Gamma correction? Explain its role in the improvement of contrast.

b) Show that subtracting the laplacian from an image is proportional to unsharp masking.

c) Discuss the JPEG compression method of digital image file.

d) What is threshold? Explain how to obtain the threshold for image segmentation.

e) Discuss the Discrete Fourier Transform. Discuss its applications in image processing.

Q5) Answer any two of the following: **[2 × 8 = 16]**

a) Explain the method of zooming of an image. Does it increase the information content of an image?

b) Explain basic principles of detecting following in the images.

i) Points ii) Lines iii) Edges

c) Explain the following image enhancement techniques in spatial domain.

i) Image negative ii) Brightness

iii) Sharpening iv) Bit plane slicing

Total No. of Questions : 5]

SEAT No. : ____

P644

[Total No. of Pages : 3

[4341] - 504

M.Sc. Tech. (Semester - V)

COMPUTER SCIENCE

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 504 : Advanced Operating Systems

(2008 Pattern)

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

Instructions to the candidates:

1) ***All questions are compulsory.***
2) ***Figures to the right indicate full marks.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***All questions carry equal marks.***

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

a) Explain memory management module of system Kernel.

b) What is the role of device number and block number field of buffer header?

c) "A process can access its u area when it executes in Kernel mode but not when it executes in user mode". Justify.

d) Explain the signal system call.

e) State the various steps for a context switch.

f) Explain the kill system call.

g) In which situations the Kernel swaps a process out if it needs a space in memory.

h) What do you mean by memory mapped I/O?

i) Explain the role of socket layer and protocol layer.

j) Explain any two options of chkconfig command.

P.T.O.

Q2) a) Attempt any one of the following : **[1 × 6 = 6]**

i) Explain the context layers of a sleeping process.

ii) Write a note on in it process.

b) Attempt any two of the following : **[2 × 5 = 10]**

i) Explain the following fields of process table :

1) State field

2) Process table entry

3) Several user identifiers

4) Process identifiers

5) Signal

ii) State the several drawbacks during the use of ptrace for process tracing.

iii) What is demand paging? Explain data structures for demand paging.

Q3) a) Attempt any one of the following : **[1 × 6 = 6]**

i) What is RPM? Explain its various options.

ii) Explain the state diagram for page aging.

b) Attempt any two of the following : **[2 × 5 = 10]**

i) Explain the behavior of following program :

```
main( )
{
    int status;
    if (fork( ) = = 0)
        execl (“/bin/date”, “date”, 0);
    wait ( & status);
}
```

ii) Write a note on start, stop and restart; service manipulation commands.

iii) Explain the socket model.

Q4) a) Attempt any one of the following: **[1 × 6 = 6]**

i) Write a note on ioctl system call.

ii) State the several parts of an executable file.

b) Attempt any two of the following : **[2 × 5 = 10]**

i) Explain the various bit fields used to support demand paging.

ii) Write a note on structure of Buffer Pool.

iii) Explain the various conditions used to identify status of buffer.

Q5) a) Attempt any one of the following: **[1 × 6 = 6]**

i) Explain the following system calls :

1) socket
2) bind
3) connect
4) listen
5) accept
6) shutdown

ii) Write a note on stream messages.

b) Attempt any two of the following : **[2 × 5 = 10]**

i) Explain the functions of a line discipline.

ii) Write a note on file system layout.

iii) How process will respond if the signal is “death of child”.

❖❖❖❖

Total No. of Questions : 5] **SEAT No. :**

P632 **[Total No. of Pages : 4**

[4341]-301

M.Sc. Tech. (Semester - III)

MATHEMATICS

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 301: Numerical Analysis

(2008 Pattern)

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 : order of convergence and determine the order of convergence of the sequence $X_n = \frac{\cos(n)}{n^2}$.

b) Define :
   i) Absolute error.
   ii) Relative error.

c) Define : The fixed point of a function and state its geometrical interpretation.

d) Find out the Newton Raphson's iterative formula to find the root of the function $f(X) = \frac{1}{\sqrt{N}}$.

e) Define a strictly diagonally dominant matrix and check whether matrix given below is strictly dominant.

$$A = \begin{bmatrix} 4 & -1 & 1 \\ 4 & -8 & 1 \\ -2 & 1 & 5 \end{bmatrix}$$

f) Define the following :
   i) Dominant eigen value.
   ii) Dominant eigen vector.

g) Given that $< \lambda, V >$ is an eigen-pair of the matrix A. Show that $< \lambda - \alpha, V >$ is an eigen-pair of the matrix $A - \lambda I$.

P.T.O.

h) If Δ denotes the forward difference operator, calculate the forward difference $\Delta f(X)$ for $f(X) = \tan^{-1}x$.

i) State ill conditioned system.

j) Define : $\| X \|_2$ of a vector X in R^2 and state the spectral Radius theorem.

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

i) Assume that $f \in C^{n+1}[a,b]$ and $X_0, X_1, ...X_N \in [a, b]$ are N+1 nodes then show that the error in the Lagrange polynomial approximation is given by :

$$E_N(X) = \frac{(X - X_0)(X - X_1).....(X - X_N) f^{N+1}(C)}{(N+1)!}$$

where $a < c < b$.

ii) Show that the iterative formula to evaluate the roots of $f(X)$ in a sequence of intervals of the type $[x_{n-1}, x_n]$ is given by

$$C_n = x_n - \frac{f(X_n)(X_n - X_{n-1})}{f(X_n) - f(X_{n-1})}$$

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

i) If 'g' is a continuous function and $\{P_n\}_{n=1}^{\infty}$ is a sequence of fixed point iterations; such that

$$\lim_{n \to \infty} p_n = p$$

then, show that p is the fixed point of $g(x)$.

ii) Consider the function $f(x) = xe^{-x}$.

1) Find the Newton-Raphson's formula $p_k = g(p_{k-1})$.

2) If $p_0 = 0.2$, find p_1, p_2 and p_3.

iii) Use Simpson's $\frac{1}{3}^{rd}$ rule to find $\int_0^6 \frac{dx}{(1+x)^2}$,

with the value of $h = 1$.

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

i) Suppose $[a, b]$ is subdivided into M-subintervals $[x_k, x_{k+1}]$ of width $h = \frac{b-a}{M}$, then the error in the composite Trapezoidal rule is given by :

$$E_T(f, h) = \frac{-(b-a) f^{(2)}(c) h^2}{12}.$$

ii) State the Simpson's $\frac{3}{8}^{th}$ rule and determine its degree of precision.

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

i) Use Gaussion elimination to construct the triangular factorization of the matrix :

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

ii) Use Runge-Kutta method to find the value of $y(0.1)$ for the initial value problem given below :

$$\frac{dy}{dx} = x + y^2,\ y(0) = 1$$

iii) Use Euler's method with $h = 0.1$ to find $y(0.3)$ for the given initial value problem :

$$\frac{dy}{dx} = x^2 + y^2,\ \ y(0) = 0$$

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

i) If $f \in C^3[a, b]$ and $x-h, x, x+h \in [a, b]$ then show that

$$f'(x) = \frac{f(x+h) - f(x-h)}{2h} + E_{trunc}(f, h)$$

where, $E_{trunc}(f, h) = \frac{-h^2 f^{(3)}(c)}{6},\ a < c < b.$

ii) Show that the Lagrangian polynomial passing through the points (x_0, y_0) and (x_1, y_1) is given by :

$$y = L_1(x) = y_0 \frac{(x - x_1)}{(x_0 - x_1)} + \frac{y_1(x - x_0)}{(x_1 - x_0)}.$$

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

i) Given that $f(x) = \frac{1}{x}$, show that the divided difference

$$f[a, b, c, d] = \frac{-1}{abcd}$$

ii) Find the Newton's polynomial of least degree which takes the values 3, 12, 15, –21 when x has values 3, 2, 1, –1 respectively.

iii) Reduce the following symmetric matrix in tri-diagonal form.

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

Q5) Attempt any TWO of the following. **[16]**

a) Solve the system of non-linear equations given below by Newton's method. Where the initial approximation

$(x_0, y_0) = (3.5, -1.8)$

$x^2 + y = 11$

$y^2 + x = 7$

b) Use House-Holder's transformation to reduce the following symmetric matrix 'A' to a tri-diagonal form.

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

c) Obtain polynomial approximation to $f(x) = e^x$, (around $x = 0$); using Taylor series expansion. Find the number of terms in the approximation so that the truncation error is less than 10^{-6}.

Total No. of Questions : 5]

SEAT No. :

P633

[Total No. of Pages : 2

[4341]-302

M.Sc. Tech. (Semester - III)

COMPUTER SCIENCE

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM-302: Software Engineering (OOS E)

(2008 Pattern)

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 software. Write attributes of good software.
b) Explain essential characteristics of Socio-Technical systems.
c) Differentiate between Fat client & Thin client.
d) What are key challenges of software engineering.
e) List different process model.
f) Write advantages of use of pair programming.
g) What are critical systems?
h) State any two fact finding techniques in analysis phase.
i) Write two advantages of inspection over testing.
j) What are UI design principles.

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

a) Explain concept of middleware.
b) "Social & political factors strongly influence the system requirements". Justify.
c) Explain various goals of software testing process.
d) What are functional and non functional requirements? Explain.
e) Explain the process activity of spiral model.

P.T.O.

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

a) Explain characteristics of Distributed system.

b) What is DFD? Explain various notations used in drawing DFD.

c) Write a short note on: Data Dictionary.

d) Explain various tools included in RAD.
(Rapid application development)

e) Explain the importance of feasibility study in requirem Engineering process.

Q4) a) Attempt any two of the following. **[10]**

i) What are state chart? Draw state chart for microwave oven model.

ii) Comment on : "There is close relationship between system availability & system security".

iii) Write a short note on : "Emergent system properties".

b) Attempt the following : **[6]**

i) Define system dependability. Explain dimensions of system dependability.

ii) Explain the factors in distributed object architecture.

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

i) What is feasibility study? Explain different types of feasibility study.

ii) Explain verification & validation.

iii) Write a short note on : "Extreme Programming".

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

i) Draw a class diagram for college admission system, which involves management, college, student, courses & subjects. Make assumptions for above specification as needed.

ii) Explain important attributes which all software products should have?

Total No. of Questions : 5]

SEAT No. :

P634

[Total No. of Pages : 2

[4341]-303

M.Sc. Tech. (Semester - III)

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM-303: Object Oriented Programming in JAVA

(2008 Pattern)

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

Instructions to the candidates :

1) ***Figures on the right indicate full marks.***
2) ***All questions carry equal marks.***

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

a) What is the main difference between String and StringBuffer?

b) What is Polymorphism?

c) What is the difference between 'throw' and 'throws' keyword in java?

d) What is meant by Abstraction?

e) What is the use of 'super' keyword in java?

f) What is serialization?

g) What is the difference between finally and finalize() in java?

h) What is type casting?

i) What are wrapper classes? Why do we need them?

j) How does the final modifier work with a class and a method?

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

a) Explain the Model View Controller (MVC) architecture.

b) Explain method overloading and overriding with suitable examples.

c) Explain the various access specifiers with respect to a package in java.

d) What are the steps in JDBC connection?

e) Explain Garbage collection in java.

P.T.O.

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

a) Given a list of marks ranging from 0 to 100, write a program to read the marks and print the number of students who have obtained the marks:

i) In the range 81 to 100.
ii) In the range 61 to 80.
iii) In the range 41 to 60 and
iv) In the range 0 to 40.

b) Write a program to read a string- "Java Programming". The program should have method to print the character in the given string as per the index. Write a program to display "Program" from the given string. The program should handle all the possible errors.

c) Write a program to create a file that can store details about five products. Details include product code, cost and number of items available. The program should also have method to read the file created and compute and print the total value of all the five products.

Q4) Attempt any two of the following. **[16]**

a) Define an exception called "NumberNotSupported" that is thrown when a negative number is entered. Write a program to read 20 numbers from keyboard and throw this exception if an negative number is entered.

b) Create a GUI application in which the font of the label text is changed as per the selected font name in the combo box for fonts. Also the background color of the form should change on selecting a color from another combo box for colors.

c) Write a JDBC program to store the Employee (Eno, Ename, Edepartment,Esalary,Edesignation) information. The program should also be able to insert, delete and update the employee information.

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

a) What are exceptions? Explain exception handling in java.

b) What is inheritance? Explain various types of inheritance supported in java with suitable examples.

c) State and explain the differences between an abstract class and interfaces.

d) Write a note on Byte and Character streams in java.

e) What is a layout manager? Explain Grid and GridBag layout.

Total No. of Questions : 5] **SEAT No. :**

P635 **[Total No. of Pages : 3**

[4341]-304

M.Sc. Tech. (Semester - III)

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATION

MIM-304: Operating Systems

(2008 Pattern)

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

Instructions to the candidates :

1) ***Neat diagrams must be drawn wherever necessary.***
2) ***Figures to the right indicate full marks.***
3) ***All questions are compulsory.***

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

a) List the two implementations feasible for LRU algorithm.

b) Name the two modes of execution of the O.S.

c) Give any two responsibilities of long-term scheduler.

d) What are the two models used in inter-process communication?

e) List benefits of multithreaded programming.

f) Give the general structure of a typical process.

g) List the four conditions necessary for the occurrence of deadlock.

h) Define :

i) Degree of multiprogramming.
ii) Safe sequence.

i) Define critical section problem.

j) Give the sequence in which a process utilizes resources in normal mode of operation.

P.T.O.

Q2) a) Attempt <u>any one</u> of the following. **[1 × 6 = 6]**

i) Consider the following snapshot of a system.

	Allocation			Max			Available		
	A	B	C	A	B	C	A	B	C
P_0	0	1	1	7	5	3	2	3	1
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			

Answer the following questions using Banker's Algorithm.

1) Find Need.
2) Is the system in a safe state?
3) If a request from process P_0 arrives for (2, 2, 1) can it be granted immediately?

ii) What is system call? Give different categories of system calls.

b) Attempt <u>any two</u> of the following : **[2 × 5 = 10]**

i) What is thread? Differentiate between single threaded and multithreaded processes with suitable diagram.

ii) What is semaphore? Explain how semaphore can be used as synchronization tool in Bounded-Buffer problem.

iii) Consider the following page reference string 1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6.

Find number of page faults for m = 3 by applying

1) LRU
2) FIFO.

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

a) Explain various steps in DMA transfer.

b) Explain the concept of multilevel queue scheduling and multilevel feedback queue scheduling.

c) Consider the following segment table.

Segment	Base	Length
0	200	600
1	2300	14
2	90	100
3	1327	580
4	1952	96

What are the physical addresses for the following logical addresses?

i) 0, 430
ii) 1, 10
iii) 3, 400
iv) 4, 112

d) Explain linked file allocation method.

e) Explain various multithreading models.

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

a) Consider the following snapshot of a system.

Job	A.T	CPU Burst
J_1	1	5
J_2	0	7
J_3	3	3
J_4	2	10

Compute Average Turn Around Time and Average Waiting Time using Round Robin with T = 2.

b) Write short note on deadlock prevention.

c) Explain how mutual-exclusion can be achieved using Test and Set ( ) instruction.

d) Explain various states of a process.

e) What is multiprocessor system? Give advantages of multiprocessor system.

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

a) Explain any two schemes for defining the logical structure of a directory.

b) "The PCB serves as the repository for any information that may vary from process to process". Comment.

c) Explain the services provided by an O.S. for ensuring the efficient operation of the system itself.

d) Write short note on CPU scheduler.

e) What is page fault? How page fault is handled by the O.S.

✷ ✷ ✷

Total No. of Questions : 5]

SEAT No. :

P636

[Total No. of Pages : 3

[4341]-305

M.Sc. Tech. (Semester - III)

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM-305: Theoretical Computer Science

(2008 Pattern)

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]**

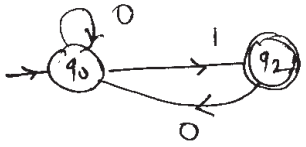
a) Consider language S*, where s = {ab, ba}. How many words in this language are of length 4? How many contains substring bbb.

b) 'Push down automata (PDA) is a six tuple. Justify.

c) Give regular expression for set of all strings such that fourth symbol from right end is 1 over {0, 1}.

d) Define language accepted by Turing Machine.

e) Give regular expression corresponding to following NFA.



f) Define terms :
   i) Kleen closure
   ii) Left linear grammar.

g) "DPDA is subset of NPDA". Justify.

h) State pumping lemma for context free languages.

i) Describe the language generated by grammar
   $S \rightarrow aSbb/A$
   $A \rightarrow Ac/c$

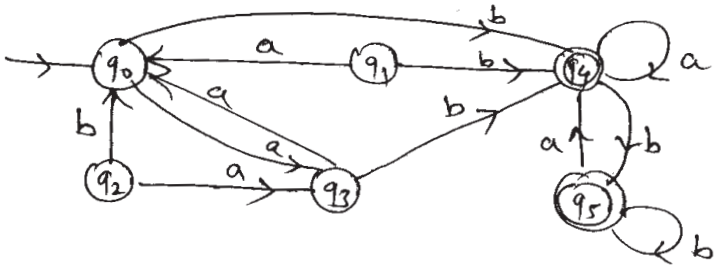
j) Define Mealy Machine.

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

i) Design Moore Machine & Mealy Machine which complements every bit in even position for an input string over alphabet {0, 1}.

P.T.O.

ii) Minimize following FA



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

i) Construct DFA that accepts the language containing strings over $\{a, b, c\}$ in which every c is followed by at least one a.

ii) Construct FA equivalent to following regular grammar

P : $S \rightarrow aS/aA/a$

$A \rightarrow bA/bB/\in$

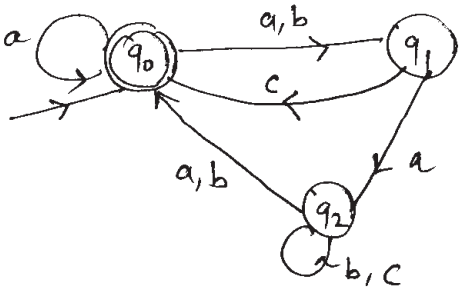
$B \rightarrow aA/bS/\in$

iii) Show that the language

$\{w_1^n / w_1 \in \{0,1\}^*, |w_1| = n, n > 0\}$ is not regular.

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

i) Give transition table for following NFA & convert it to DFA.



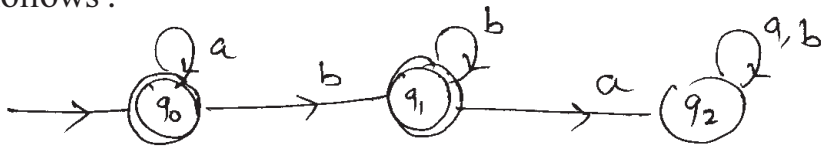
ii) Construct regular grammar for a language over $\{a, b, c\}$ starting with b and having odd number of c's.

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

i) Construct CFG for language $L = \{a^n b^i c^n / n \geq 1, i \geq 0\}$

ii) Show that $L = \{a^m b^m c^m / m > 0\}$ is not CFL.

iii) Find regular expression for the FA whose transition diagram is as follows :



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

i) Convert following CFG to GNF G = $\{S \rightarrow AB, A \rightarrow SB/a, B \rightarrow AB/b\}$

ii) Construct Turing Machine for $L = \{a^n b^n c^n / n \geq 1\}$

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

i) Construct PDA for language
L = $\{wcw^r / w \in (0 + 1)^*\}$
w^r is reverse of w

ii) Convert following right linear grammar to left linear grammar
$\{S \rightarrow bB, B \rightarrow bc / aB, C \rightarrow a, B \rightarrow a\}$

iii) Convert following grammar to CNF
$\{S \rightarrow aSa / bSb / a / b / aa / bb\}$

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

i) Construct Turing Machine to recognize language
$L = \{a^m b^n c^m / m, n \geq 0\}$

ii) Construct CFG equivalent to PDA.
$M = (\{q_1, q_2\}, \{0,1\}, \{R, B\}, \delta, q_1, R, \phi)$
Where
$\delta(q_1, 0, R) = (q_1, BR)$
$\delta(q_1, 0, B) = (q_1, BB)$
$\delta(q_1, 1, B) = (q_2, \in)$
$\delta(q_2, \in, B) = (q_2, \in)$
$\delta(q_2, \in, R) = (q_2, \in)$

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

i) Construct equivalent PDA for grammar in GNF with productions.
$\{S \rightarrow aABA / aBB, A \rightarrow bA / b, B \rightarrow cB / c\}$

ii) Explain universal Turing Machine.

iii) Show that CFL's are not closed under complementation.

Total No. of Questions : 5]

SEAT No. :

P637

[Total No. of Pages : 3

[4341]-401

M.Sc. Tech. (Semester - IV)

MATHEMATICS

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 401: Topology

(2008 Pattern)

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) Find all open and closed subsets of X = {a, b, c}
where topology on X is :
T = {ϕ, X, {a}, {b}, {a, b}, {b, c}}.

b) Is the collection
T = {U|X-U is countable or all of X}
a topology on X? Justify your answer.

c) If X = R, Y = [0, 1] ∪ {2}, then answer the following questions :
i) Is {2} open in Y?
ii) Is {2} open in X?

d) Let X = R with usual topology,
Y = (0, 1] be a subspace of R,
A = $(0, \frac{1}{2})$.
Find :
i) Closure of A in X.
ii) Closure of A in Y.

e) State tube lemma.

f) Show that R^n is locally compact space.

g) State Tychonoff theorem for countable products.

h) State Urysohn Lemma.

i) Define Lindelöf space.

j) Define Normal topological space.

P.T.O.

Q2) A) Answer any ONE of the following : **[6]**

a) If B is a basis for the topology on X and C is a basis for topology on Y, then the collection.
$D = \{B \times C / B \in B, c \in C\}$ is a basis for the topology on X×Y.

b) Let Y be a subspace of X. Then a set A is closed in Y if and only if it equals the intersection of a closed set of X with Y.

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

a) Let $f: A \to B$ and $g: C \to D$ be continuous functions. Let us define a map: $f \times g: A \times C \to B \times D$ as : $(f \times g)(a \times c) = f(a) \times g(c)$
Show that $f \times g$ is a continuous function.

b) If X is Hausedorff space, then a sequence of points of X converges to atmost one point of X.

c) Let A, B denote subsets of a space X, then prove the following :

i) If $A \subset B$ then $\overline{A} \subset \overline{B}$

ii) $\overline{A \cup B} = \overline{A} \cup \overline{B}$

Q3) A) Attempt any ONE of the following. **[6]**

a) State and prove Pasting lemma.

b) Let $\{X_\alpha\}$ be an indexed family of spaces; let $A_\alpha \subset X_\alpha$ for each α.
If πX_α is given either the box topology or product topology, then
$\pi\overline{A}_\alpha = \overline{\pi A_\alpha}$

B) Attempt any TWO of the following. **[10]**

a) Show that the function
$f : [0, 1] \to s^1$, where
$s^1 = \{x \times y \mid x^2 + y^2 = 1\}$
defined by
$f(t) = (\cos 2\pi t, \sin 2\pi t)$
is continuous but not homeomorphism.

b) Let $\{A_n\}$ be a sequence of connected subsets of X, such that $A_n \cap A_{n+1} \neq \phi, \forall_n$. Show that $\bigcup_n A_n$ is connected.

c) Show that a finite union of compact subspaces of a topological space X is compact.

Q4) A) Answer any ONE of the following: **[6]**

a) Prove that a topological space X is locally connected if and only if for every open set U of X, each component of U is open in X.

b) Show that every compact topological space is limit point compact.

B) Answer any TWO of the following : **[10]**

a) Let X be a locally compact Hausdorff space and A be a subspace of X. Show that if A is open in X or closed in X, then A is locally compact.

b) Prove that continuous image of a path connected space is path connected.

c) Prove that a closed subspace of a Lindelöf space is Lindelöf.

Q5) A) Attempt any ONE of the following. **[6]**

a) Prove that subspace of a first countable space is first countable and a countable product of a first countable space is first countable.

b) Every compact Hausdorff space is normal.

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

a) Show that every locally compact, Hausdorff space is regular space.

b) Give an example of a topological space X which is limit point compact but not compact.

c) Let $\{A_\alpha\}$ be a collection of connected subspaces of X. Let A be a connected subspace of X. Show that if $A \cap A_\alpha \neq \phi, \forall_\alpha$, then $A \cup (\bigcup_\alpha A_\alpha)$ is connected.

Total No. of Questions : 4]

SEAT No. :

P640

[Total No. of Pages : 3

[4341] - 404

M.Sc. Tech. (Semester - IV)

MATHEMATICS

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 404 : Design and Analysis of Algorithms

(2008 Pattern)

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

Instructions to the candidates :

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

Q1) Attempt any Eight of the following : **[8 × 2 = 16]**

a) Define space complexity and time complexity.

b) Give an example of a problem which is NP-Complete.

c) What are different types of Heaps in Heap sorting?

d) Which idea is used in compression technique?

e) Define parent node with example.

f) State true or false : $f(n) + g(n) = 0 (\min (f(n), g(n)))$.

g) Give big 0 estimate for the following : Sum of first n positive integers.

h) Fill in the blank :
Greedy method is used to solve _____ problems.

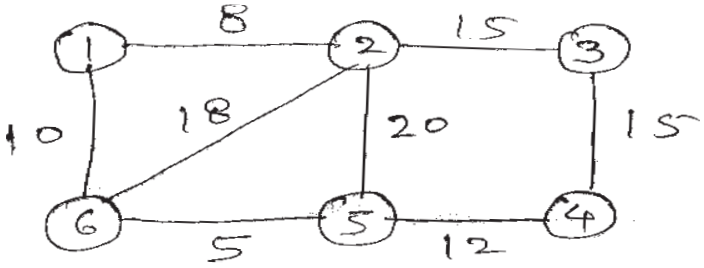
i) Define the term 'Algorithm'.

j) Explain the terms : Flow, Residual network in a graph.

P.T.O.

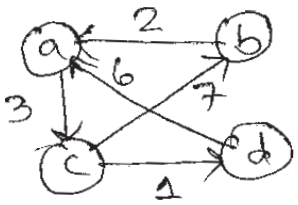
Q2) Attempt any two of the following : **[2 × 12 = 24]**

a) Give Kruskal's algorithm to find minimal spanning tree for given weighted connected graph G. Apply Kruskal's algorithm for following graph G.



b) Explain the concept 'Mergesort'. Write an algorithm to merge two sorted arrays. What is time complexity of mergesort. Give one example.

c) Discuss Floyd - Warshall algorithm for all pairs shortest path for a given weighted directed graph G = (V, E) with n vertices Apply Floyd - War shall algorithm for the following graph.



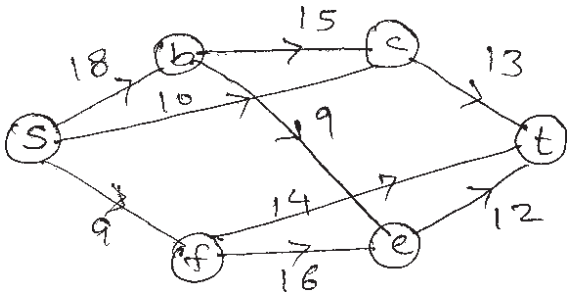
Q3) Attempt any two of the following : **[2 × 12 = 24]**

a) Explain : Dynamic Programming. What is Principle of optimality? Discuss algorithm for matrix chain multiplication problem.

b) What is Heap property? What are uses of 'Heap'? Write an algorithm for Heap sort.

c) i) Write a note on 'Elements of Greedy strategy'.

ii) Calculate maximal flow in the following network using Ford Fulkerson algorithm.



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

a) Write a note on Travelling salesman problem.

b) When a decision problem D is said to be NP - Complete? Explain the procedure to show a decision problem to be NP - Complete.

c) Write an algorithm for topological sorting (linear ordering to directed a cyclic graph).

d) Rank following functions in their increasing order of growth rates

e^n, n^n, n! , $\log_e n^n$, n^2.

e) Apply quicksort to sort the list E, X, A, M, P, L, E in alphabetical order.

f) Construct Huffman tree for following frequencies

a : 1, b : 1, c : 2, d : 3, e : 5, f : 8.

⌘⌘⌘

Total No. of Questions : 5] **SEAT No. :**

P641 **[Total No. of Pages : 7**

[4341]-501

M.Sc. Tech. (Semester - V)

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM-501: Operations Research and Optimizing Techniques

(2008 Pattern)

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 single memory, non-programmable scientific calculator is allowed.***
4) ***Graph papers will be supplied on demand.***

Q1) Attempt each of the following (Eight) : **[2 marks each]**

a) Define slack and surplus variables in an LPP.

b) Solve the following LPP :

Max $z = x_1 + x_2$ subject to the constraints

$x_1 + x_2 \leq 1,$

$-3x_1 + x_2 \geq 3$ and

$x_1, x_2 \geq 0.$

c) Prove that the set of all feasible solutions of an LPP form a convex set.

d) Obtain the dual of the following LPP :

Max $z = x_1 - 2x_2 + 3x_3$ subject to the constraints :

$-2x_1 + x_2 + x_3 = 2,$

$2x_1 + 3x_2 + 4x_3 = 1,$

$x_1, x_2, x_3 \geq 0.$

P.T.O.

e) State at least four guidelines for network drawing and numbering of the events.

f) Define the saddle point of a payoff matrix. Further, explain the procedure to detect saddle point.

g) What is an assignment problem and how do you interpret it as an L.P.P.

h) Explain the primal-dual relationships.

i) How degeneracy is located in a transportation model?

Q2) Attempt <u>any four</u> of the following. **[4 marks each]**

a) Solve the following 2×4 game graphically :

	Player B			
Player A	3	3	4	0
	5	4	3	7

b) Show that an assignment problem is a special case of a transportation problem.

c) The standard weight of a special purpose brick is 5 kg. and it contains two basic ingredients B_1 and B_2. The ingredient B_1 costs Rs. 5 per kg and B_2 costs Rs. 8 per kg. Strength considerations dictate that the brick should not contain more than 4 kg of B_1 and minimum of 2 kg of B_2. Since the demand for the product is likely to be related with the price of the brick, find out graphically the minimum cost of the brick satisfying the above conditions.

d) Prove that the dual of the dual is primal.

e) A dairy firm has three plants located in a state. The daily milk production at each plant is as follows :

Plant 1	6 million lits.
Plant 2	1 million lits.
Plant 3	10 million lits

Each day, the firm must fulfil the needs of its four distribution centers. Minimum requirement at center is as follows :

Distribution Center 1	7 million lits.
Distribution Center 2	5 million lits.
Distribution Center 3	3 million lits.
Distribution Center 4	2 million lits.

Cost in hundreds of rupees of shipping one million lit. from each distribution center is given in the following table :

	D_1	D_2	D_3	D_4
Plant P_1	2	3	11	7
Plant P_2	1	0	6	1
Plant P_3	5	8	15	9

Find initial basic feasible solution for given problem by using North-West corner rule.

Q3) Attempt any <u>four</u> of the following : **[4 marks each]**

a) Using Big-M Method, solve :

Max $Z = 3x_1 + 2x_2$ subject to constraints

$2x_1 + x_2 \leq 1,$

$3x_1 + 4x_2 \geq 4,$

$x_1, x_2 \geq 0.$

b) Explain Vogel's Approximation Method.

c) Solve the following game whose payoff matrix given below:

Player B

Player A	B_1	B_2	B_3	B_4
A_1	2	3	4	0
A_2	3	4	2	4
A_3	4	2	4	0
A_4	0	4	0	8

d) An airline company has drawn up a new flight schedule involving five flights. To assist in allocating five pilots to the flights, it has asked them to state their preference scores by giving each flight a number out of 10. The higher the number, greater is the preference. Certain of these flights are unsuitable to some pilots owing to domestic reasons. These have been marked with a ×.

	Flight 1	Flight 2	Flight 3	Flight 4	Flight 5
Pilot A	8	2	×	5	4
Pilot B	10	9	2	8	4
Pilot C	5	4	9	6	×
Pilot D	3	6	2	8	7
Pilot E	5	6	10	4	3

What should be the allocation of the pilots to the flights in order to meet as many as preferences possible.

e) A company has three production facilities S_1, S_2 and S_3 with production capacities of 7, 9 and 18 units per week of a product, respectively. These units are to be shipped to four warehouses D_1, D_2, D_3 and D_4 with requirement of 5, 6, 7 and 14 units per week, respectively. The transportation cost (in rupees) per unit between factories to warehouse are given in the following table.

	D_1	D_2	D_3	D_4	Capacity
S_1	19	30	50	10	7
S_2	70	30	40	60	9
S_3	40	8	70	20	18
Demand	5	8	7	14	34

Formulate this transportation problem as an LP model to minimize the total transportation cost.

Q4) Attempt any two of the following : **[8 marks each]**

a) Consider the following LPP :

Max $Z = 3x_1 + 5x_2$ subject to the constraints

$3x_1 + 2x_2 \leq 18,$

$x_1 + 2x_2 \leq 4,$

$x_2 \leq 6$ and

$x_1, x_2 \geq 0.$

Obtain an optimal solution of the given LPP. Suppose variable x_6 is added to the given LPP. Then obtain an optimal solution to the resulting LPP. It is given that the coefficient of x_6 in the constraint of the problem are 1,1 and 1, and its coefficient in the objective function is 2.

b) A company has received a contract to supply gravel for three new construction projects located in towns A, B and C. Construction engineers have estimated the required amount of gravel which will be needed at these construction projects.

Project Location	Weekly Requirement (Truckloads)
A	72
B	102
C	41

The company has 3 gravel pits located in towns X, Y and Z. The gravel required by the construction projects can be supplied by three pits. The amount of gravel which can be supplied by each pit is as follows :

Plant	X	Y	Z
Available truckloads	76	82	77

The company has computed the delivery cost from each pit to each project site. These costs (in Rs.) are shown in the following table.

		Project Location		
		A	B	C
Pit	X	4	8	8
	Y	16	24	16
	Z	8	16	24

Schedule the shipment from each pit to each project in such manner so as to minimize the total transportation cost within the constraints imposed by pit capacities and project requirements. Also find the minimum cost.

c) i) Describe linear programming method to solve the two-person zero-sum game.

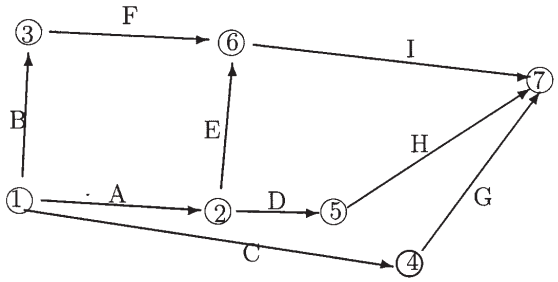
ii) What conditions must exist in a simplex table to eastablish the existence of an alternative solution? No feasible solution? Unbounded solution? Degeneracy?

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

a) The following network diagram represents activities associated with a project :

Activities	A	B	C	D	E	F	G	H	I
Optimistic time t_o	5	18	26	16	15	6	7	7	3
Pessimistic time t_p	10	22	40	20	25	12	12	9	5
Most likely time t_m	8	20	33	18	20	9	10	8	4

Determine the expected activity time, variance and the critical path.



b) i) Describe main steps of dual simplex algorithm.

ii) Write a short note on sensitivity analysis.

c) A solicitors' firm employs typists on hourly piece-rate basis for their daily work. There are five typists and their charges and speed are different. According to an earlier understanding only one job is given to one typist and the typist will fully complete the job and is paid for a full hour even if he works for a fraction of an hour. Find the least cost allocation for the following data.

Typist	Rate/Hour(Rs.)	No. of pages types/Hour
A	5	12
B	6	14
C	3	8
D	4	10
E	4	11

Job	No. of pages
P	199
Q	175
R	145
S	298
T	178