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

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[Total No. of Pages :3

[4141] - 201

M.Sc. Tech. (Sem. - 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: **[8 × 2 = 16]**

a) Define outer measure m* A of a set A $\subseteq$ R.

b) Let A be a sigma Algebra of a non-empty set X. Show that A is closed under countable intersection.

c) If m* A = 0 then show that for any set B $\subseteq$ R, m* (A $\cup$ B) = m*B.

d) Let A $\subset$R, then characteristic function of A is defined and denoted as :

$$\chi_A(x) = \begin{cases} 1, & \text{if } x \in A \\ 0, & \text{if } x \notin A. \end{cases}$$

then show that set A is measurable if and only if χ_A is measurable.

e) If A_1, A_2 are measurable sets with finite measure and if $A_1 \cap A_2 = \phi$ then show that for *f* a bounded measurable function.

$$\int_{A_1 \cup A_2} f = \int_{A_1} f + \int_{A_2} f .$$

f) Discuss the differentiability of the function $f(z) = \bar{z}$ in C.

g) Determine whether the function *f (z) = xy + iy* is analytic every where?

h) Define residue at a pole.

i) Find radius of convergence of the complex series $\sum_{n=1}^{\infty} n Z^n$.

j) Show that $\int_C \frac{e^{2\pi z}}{z-a} dz = 2\pi i e^{2\pi a}$

Where C is the circle $|z-a|=2$.

P.T.O.

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

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

$$m^*\left[\bigcup_{n=1}^{\infty} A_n\right] \leq \sum_{n=1}^{\infty} m^* A_n.$$

ii) Let D be a measurable subset of R and $f : D \to R_\infty$ be a function. Then following are equivalent.

a) f is measurable *i.e.* $U_\alpha = \{x \in D \mid f(x) > \alpha\}$ is measurable, $\forall \alpha \in R$.

b) $\forall \alpha \in R$, the set $C_\alpha = \{x \in D \mid f(x) \geq \alpha\}$ is measurable.

c) $\forall \alpha \in R$, the set $V_\alpha = \{x \in D \mid f(x) < \alpha\}$ is measurable.

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

i) Let $\{E_n\}$ be an infinite decreasing sequence of measurable sets in R. i.e $E_n \supseteq E_{n+1}$, $\forall n$. Let mE, be finite. prove that.

$$m\left(\bigcap_{n=1}^{\infty} E_n\right) = \lim_{n \to \infty} mE_n.$$

ii) Let D be a measurable set and $f, g : D \to R$ be bounded measurable functions. Then show that Cf and $f + g$ are bounded measurable functions for all $C \in R$.

iii) Let $A, B \subseteq R$ then show that

a) $\chi_{AnB} = \chi_A \cdot \chi_B$

b) $\chi_{A \cup B} = \chi_A + \chi_B - \chi_A . \chi_B$

c) $\chi_{A^1} = 1 - \chi_A$, $A^1 = R - A$.

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

i) State and prove Fatou's lemma.

ii) State and prove bounded convergence theorem.

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

i) Let f and g be non-negative functions which are measurable on a measurable set E such that. $f \leq g$ almost every where on E.

then show that $\int_E f \leq \int_E g$ and hence.

show that $\left|\int_E f\right| \leq \int_E |f|$

ii) Let f and g be integrable functions and $a, b \in R$ then show that $\int (af + bg) = a\int f + b\int g$

iii) Let f be non negative measurable function on a measurable set E, Such that $f \equiv 0$ almost every where. Then show that $\int_E f = 0$.

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

i) Let $f(z) = u + iv$ be a complex valued function defined on a domain D. Let $Z_0 = x_0 + iy_0 \in$ D. Let f (z) be differentiable at Z_0. Show that the cauchy- Riemann equations are satisfied at $Z_0 = x_0 + iy_0$.

ii) Show that a bounded entire function is constant.

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

i) Show that $u(x,y) = \frac{1}{2} \log (x^2+y^2)$ is harmonic. Obtain its harmonic conjugate.

ii) Show that cross ratio is invarient under Möbius transformation.

iii) Evaluate : $\int_C \frac{z+6}{z^2-4}\, dz$ where

a) C is the circle $|z|=1$

b) C is the circle $|z+2|=1$

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

i) State and prove Cauchy's Residue Theorem.

ii) Show that the composition of two Möbius transformations is also a Möbius transformation.

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

i) Obtain the Laurent's series expansion for

$$f(z) = \frac{z^2-1}{(z+2)(z+3)} \text{ in } 2 < |z| < 3.$$

ii) Use Residue theorem to evaluate

$$\int_C \frac{1-2Z}{z(z-1)(z-2)}\, dz, \text{ where C is the Circle } |z| = \frac{3}{2}.$$

iii) Let D be a simply connected domain. Let f be analytic in D. Let γ be a closed contour in D. Let $a \in$ D- $\{\gamma\}$; in usual notation, prove that,

$$f(a).n(\gamma,a) = \frac{1}{2\pi i} \int_\gamma \frac{f(z)}{z-a}\, dz.$$

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Total No. of Questions : 5]

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[Total No. of Pages : 3

[4141] - 102
M.Sc. Tech.
MATHEMATICS
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM 102 : Algebra - I
(Sem. - 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) Let G be a group and $g \in G$. Define $\phi : G \to G$ by $\phi(x) = gxg^{-1}$. Show that ϕ is a group homomorphism. Find ker (ϕ).

b) If every subgroup of a group *G* is normal then *G* is abelian. Is this statement true or false? Justify!

c) Express σ = (1, 2, 3)(4,5)(1, 6, 7, 8, 9)(1, 5) as product of disjoint cycles.

d) If *H* and *K* are subgroups of G then show that $H \cap K$ is a subgroup of G.

e) Does there exist an isomorphism between Z_5^* and Z_8^*, where Z_n^* denote the set of integers less than or equal to *n* and relatively prime to n? Justify!

f) Let R be a ring such that $x^2 = x$ for every $x \in \mathrm{R}$. Show that $x + x = 0$ for every $x \in \mathrm{R}$.

g) Show that $f(x) = x^3 - x + 1$ is an irreducible polynomial in $Z_3[x]$.

h) Give an example of a commutative ring R and a subring S such that both R and S are rings with unity but the unity in R is different from unity in S.

i) Determine all the units in Q[*x*].

j) Show that $I = \{xf(x) + 3g(x) / f, g \in Z[x]\}$ is an ideal of Z[*x*].

P.T.O.

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

i) Show that every group of order p^n has non - trivial center.

ii) State and prove Cayley's theorem.

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

i) Show that A_4 has no subgroup of order 6.

ii) Let H and K be normal subgroups of G, for all h such that $H \cap K = \{e\}$. Show that $hk = kh$, for all $h \in H, k \in K$.

iii) Determine the smallest subgroup of S_n which contains $\sigma = (1, 2)$ and $\tau = (1, 2, ..., n)$

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

i) Let G be a group and H be a subgroup of G. For $a, b \in G$, define $\sim$ by $a \sim b$ if and only if $ab^{-1} \in H$. Show that $\sim$ is an equivalence relation. Find equivalence class of $a \in G$. Show that there is a bijection between H and equivalence class of a, where $a \in G$. Hence , or otherwise prove that if G is a finite group then $o(H)$ divides $o(G)$.

ii) Let G be a group and H, K be normal subgroups of G such that $K \subset H$. Then show that H/K is a normal subgroup of G/K. Further, show that $(G/K)/(H/K) \cong G/H$.

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

i) Show that a group of order 56 cannot be simple.

ii) Show that any abelian group of order 21 is cyclic.

iii) Let G be a group and $a \in G$ and $o(a) = m$. Show that $a^n = e$ if and only if m divides n.

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

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

ii) Let R be a commutative ring with unity and let A be an ideal of R. Then show that R/A is an integral domain if and only if A is a prime ideal.

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

i) Let p be an odd prime. Show that

$$f(x) = x^{p-1} - x^{p-2} + ... + x^2 - x + 1$$

is an irreducible polynomial in Q[x].

ii) Let R be a ring of 2×2 matrices having real entries. Show that R has only trivial ideals.

iii) Let R be a commutative ring with unity and I, J be ideals of R. Define

$$I + J = \{a + b \mid a \in I, b \in J\}$$

$$IJ = \left\{ \sum_{i=1}^{n} a_i b_i \mid a_i \in I, b_i \in J \text{ and } n \in \mathrm{N} \right\}$$

Show that $I + J$, $I\,J$ are ideals of R.

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

i) Define characteristic of an integral domain. Show that characteristic of an integral domain is either 0 or a prime. Give an example of an infinite integral domain having prime characteristic. Does there exist a finite integral domain having characteristic 0? Justify!

ii) If I and J are ideals in a commutative ring R, then prove that the quotient ring $(I + J) / J$ is isomorphic to the quotient ring $I / I \cap J$.

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

i) Show that every ideal of a Euclidean domain is a principal ideal.

ii) Let $R = Z_7[x] / \langle x^2 + 1 \rangle$. Show that R is a field. How many elements are there in R?

iii) Find gcd$(2 + 3i, 5 + 7i)$ in the ring of Gaussian integers $Z[i]$.

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Total No. of Questions : 5]

SEAT No. :

P886

[Total No. of Pages : 3

[4141] - 104

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

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 104 : 'C Programming'

(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) Explain the syntax of switch.

b) Define compilers.

c) Explain the use of continue statement.

d) Explain the precedence and associativity rules.

For the following statements. Write a function with syntax and example. (e – h).

e) Concatenate two strings.

f) Find length of a string.

g) Function to allocate memory.

h) Open a file in append mode.

i) State different escape sequences.

j) Define - pointer.

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

a) Explain the conditional statement if-else. With the example, explain nested if-else structure.

b) Write a program to accept a string and check if it is palindrome. Palindrome strings have reads same from the begining or from the end.

ex : string : 'Madam' is palindrome.

string : 'Sir' is not palindrome.

c) Write a program to accept two numbers and find their GCD.

P.T.O

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

a) Write a program to accept an integer array and find out maximum number of it.

b) What is a function? What are advantages of functions?

c) Write a note on scope of variables.

d) Explain the looping structure. For, with its syntax and suitable example.

e) Write a note on structures.

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

a) Write the output of :

```
# include < stdio.h>
main ( )
{  int   x = 10, y = 20;
       printf ("%d %d %d %d", x ++, x*y, – –y, y);
}
```

b) Find the output of following code :

```
# include < stdio.h>
main ( )
{  int     i;
   For (i = 0; i < 10; i ++)
      { printf (" \n %d", i);
      i + +;
      }
}
```

c) Find the output of code :

```
# include < stdio.h>
main ( )
{  int   p = 10;
       printf ("%d %d", p << 2, p >> 2);
}
```

d) Define macro

e) Explain different logical operators.

f) Differentiate between break and continue statement.

g) Write the use and syntax of fscanf ( ) function.

h) State True / False and justify "C is middle level language".

i) Explain different preprocessor directives.

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

a) Define : array. What are different types of arrays. Give suitable example.

b) What is recursion? Explain with suitable example.

c) Write a program to accept a file name as command line argument and count the number of characters and spaces in it. Print this as result.

d) What is file? What are different types of files?

e) Explain how pointers are passed to functions and how pointers are returned from functions.

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Total No. of Questions : 5]

SEAT No. : ____

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[Total No. of Pages : 2

[4141] - 302

M.Sc. Tech. (Sem. - III)

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 302 : Software Engineering

(2008 Pattern)

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

Instructions to the candidates:

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

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

a) Define system.

b) What is software Engineering?

c) What is a software process?

d) Give any 2 UML graphical notation.

e) Give any 2 essential characteristics of socio - technical systems.

f) What are the two process model that are used for process iteration?

g) Define : fat and thin client model.

h) Give any 2 tool that are included in RAD environment.

i) Define : unit test.

j) What are concurrent objects? Give in brief.

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

a) What are the key challenges facing software engineering?

b) Explain the activities involved in system design process.

c) Explain : Spiral development process model.

d) Give the stages of object oriented design.

e) Explain Agile methods.

P.T.O

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

a) Explain functional and non-functional requirements in software requirements.

b) What are Extreme programming? Explain in brief.

c) What are the key aspects of Behaviour model?

d) Explain the factors in distributed object architecture.

e) Explain Integration testing in detail.

Q4) Attempt any two of the following. **[2 × 8 = 16]**

a) Draw a use - case diagram for a library system. The system comprises of library user, supplier, staff and the following process.

i) Article search ii) Article printing

iii) User administration iv) Catalogue services.

Identify the internal flow of each process in the system module. Assume any other method of activity that is relevant to the system.

b) A petrol (gas) station is to be set up for fully automated operation. Drivers snipe their credit card through a reader connected to the pump. The card is verified by communication with a credit company computer; and a fuel limit is established. The driver may then take the fuel required. when fuel delivery is complete and the pump hose is returned to its hokter, the driver's credit card account is debited with the cost of the fuel taken. The credit card is returned after debiting. If the card is invalid, the pump returns it before fuel is dispensed. Identify possible objects and develop a sequence diagram and state diagram for the above casestudy.

c) i) What are domain requirements? Explain in detail.

ii) Explain the purpose of Test automation.

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

a) Explain clean room software development.

b) Explain class and object model.

c) Give the four main phases of requirement engineering process and explain in brief.

d) Write a note on : Inheritance model.

e) Explain user requirement and system requirement.

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

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[4141] - 302

M.Sc. Tech. (Sem. - III)

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 302 : Databases

(2004 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) Define : Schema.
b) What do you mean by closure of an attribute?
c) What is functional dependency?
d) Give the usage of select (σ) in relational algebra.
e) Define : Tuple calculus.
f) Define : Entity.
g) Give any 2 aggregate functions in SQL.
h) What is DDL statements?
i) What do you mean by sequences?
j) Define : Instances.

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

i) Consider the database
Branch (br-name, br-city, assets).
Account (Acc-no, Balance).
Customer (cust-name, city, sheet).
loan (loan-no, amt)
Write the relational algebra expressions for the following:
A) Find all customers of the bank who have an account but not a loan.
B) Find the customers who have both a loan and an account.
C) Find name of all branches in the loan relation.

ii) Explain : Cartesian product and Natural Join with an example.

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

i) Explain B^+ tree organization.
ii) Explain Triggers in PL|SQL.
iii) What do you mean by Trivial and Non-Trivial dependency?

P.T.O

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

i) Draw an ER diagram for a Ship-tracking database. Ship has a ship-type for its own characterization. Each and every ship is recognized through a port and has a number of visits. Port are related to state/ country and a sea / ocean / lake type. Ship should also be recorded according to its ship-movement. Assume your own assumptions.

ii) Explain data model in Databases.

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

i) How do you differentiate Relational calculus and Algebra?

ii) Explain loop statements in PL|SQL.

iii) Explain dependency preservation.

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

i) Explain Normalization. Give the stages of first, second and third Normal form.

ii) Explain static and dynamic Hashing.

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

i) Consider the database:

Emp(Emp-no, name, salary)

works(dept-no, dept-name, emp-no).

A) Insert a row in Emp table.

B) Update dept-name from “ABC” to “XYZ”.

C) Delete all the rows in works table.

ii) What are joins? Explain in detail.

iii) Explain : Cursors in PL |SQL.

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

a) Explain the usage of Relational database.

b) What do you mean by grouping and ungrouping in relational algebra?

c) Explain : Aggregation.

d) Give the difference between Specialization and Generalization.

e) Give the structure of PL | SQL.

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Total No. of Questions : 5]

SEAT No. : ____

P902

[Total No. of Pages : 6

[4141] - 501
M.Sc. Tech.
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 501 : Operations Research & Optimizing Techniques
(Sem. - V) (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 :

i) Surplus variables.

ii) Basic solution to L.P.P.

b) Convert the following L.P.P. into standard form

Max $Z = 3x_1 + 5x_2$

Subject to the constraints.

$2x_1 + 3x_2 \leq 8$

$2x_1 + 5x_2 \leq 10$

$x_1, x_2 \geq 0$

c) Find feasible space if it exists for the following L.P.P.

Maximize $Z = 4x_1 + 2x_2$

Subject to the constraints

$2x_1 + 3x_2 \leq 18$

$x_1 + x_2 \geq 10$

$x_1, x_2 \geq 0$

d) Can a L.P.P. have exactly four optimum solutions? Justify your answer.

e) Explain 'Degeneracy' in transportation problem.

f) Explain when there exists an alternate solution for given transportation model.

P.T.O.

g) Explain maximization model in an assignment problem. How to solve it? Explain in steps.

h) Define :

i) Optimal strategy.

ii) Saddle point.

i) Find the ranges of values of p and q having saddle point at (2, 2).

		Player B		
		B_1	B_2	B_3
Player A	A_1	2	4	5
	A_2	10	7	q
	A_3	4	p	6

j) Define :-

i) Optimistic time.

ii) Pessimistic time.

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

a) A company is making two products A and B. The cost of producing one unit of product A and B is Rs. 60 and Rs. 80 respectively. As per the agreement, the company has to supply atleast 200 units of product B to its regular customers. One unit of product A requires one machine hour where as product B has machine hours available abundantly within the company. Total machine hours available for product A are 400 hours. One unit of each product A and B requires one labour hour each and total of 500 labour hours are available. The company want to minimize the cost of production by satisfying the given requirements. FORMULATE the problem as a linear programming problem.

b) Explain 'Least cost Method' for finding an initial solution of a transportation problem.

c) For the following linear programming problem,

Min $Z = 1200x_1 + 900x_2 + 1500x_3$

Subject to the constraints

$x_1 + 3x_2 + x_3 \geq 12$

$2x_1 + 2x_2 + x_3 \geq 10$

$x_1 + x_2 + 5x_3 \geq 14$

$x_1, x_2, x_3 \geq 0$

The final simplex table is given below.

$C_j \rightarrow$			1200	900	1500	0	0	0	M	M	M
$C_j \rightarrow$			X_1	X_2	X_3	S_1	S_2	S_3	A_1	A_2	A_3
C_B	b	B									
900	4	X_2	1	1	0	0	$-5/9$	$1/9$			
0	2	S_1	2	0	0	1	$-14/9$	$1/9$			
1500	2	X_3	0	0	1	0	$1/9$	$-2/9$			
Z_j			900	900	1500	0	$-1000/3$	$-700/3$			
$C_j - Z_j$			300	0	0	0	$1000/3$	$700/3$			

From above table, answer the following questions.

i) Is the above solution optimal? If yes what it is?

ii) Is the above solution unbounded? Justify.

iii) Is the above solution degenerate? Justify.

d) Solve the following L.P.P. by graphical method.

Max $Z = 4x_1 + 3x_2$

Subject to the constraints.

$3x_1 + 4x_2 \leq 24$

$8x_1 + 6x_2 \leq 48$

$x_1 \leq 5$

$x_2 \leq 6$

$x_1, x_2 \geq 0$

e) Write dual of the following primal problem

Minimize $Z = 2x_1 + 3x_2 + 4x_3$

Subject to the constraints

$2x_1 + 3x_2 + 5x_3 \geq 2$

$3x_1 + x_2 + 7x_3 = 3$

$x_1 + 4x_2 + 6x_3 \leq 5$

$x_1, x_2 \geq 0$, x_3 is unrestricted in sign.

Q3) Solve any <u>two</u> of the following : **[16]**

a) Consider following transportation problem.

	W_1	W_2	W_3	W_4	W_5	$a_i \downarrow$
P_1	20	28	32	55	70	50
P_2	48	36	40	44	25	100
P_3	35	55	22	45	48	150
$b_j \rightarrow$	100	70	50	40	40	

i) Is above Transportation problem balanced?

ii) Find an initial basic feasible solution by North - West - Corner - rule.

iii) Check optimality by Modified distribution method.

b) Solve the following L.P.P. by using Big - M method.

Minimize $Z = 2x_1 + 3x_2$

Subject to the constraints

$x_1 + x_2 \geq 5$

$x_1 + x_2 \geq 6$

$x_1, x_2 \geq 0$

c) A company has one surplus truck in each of the cities A, B, C, D, and E, and one deficit truck in each of the cities 1, 2, 3, 4, and 5, 6 the distance between the cities in kilometres is shown in the matrix below.

Find the assignments of trucks from cities in surplus to cities in deficit, so that the total distance covered by vehicles is minimum.

	1	2	3	4	5	6
A	12	10	15	22	18	8
B	10	18	25	15	16	12
C	11	10	3	8	5	9
D	6	14	10	13	13	12
E	8	12	11	7	13	10

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

a) i) Explain the term

'Two person zero sum game'.

ii) Obtain the optimal strategies for both the players and value of the game for two person zero sum game whose pay - off matrix is given below :

		Player B	
		B_1	B_2
Player A	A_1	–6	7
	A_2	4	–5
	A_3	–1	–2
	A_4	–2	5
	A_5	7	–6

b) i) Explain how to resolve degeneracy in transportation problem.

ii) Explain Hungerian Algorithm to solve an assignment problem.

c) i) Explain the term 'Dual of Dual is primal' in Linear programming problem.

ii) Five different machines can do any of the five required jobs, with different profits resulting from each assignment as shown in the following table. Find out maximum profit possible through optimal assignments.

	A	B	C	D	E
1	30	37	40	28	40
2	40	24	27	21	36
3	40	32	33	30	35
4	25	38	40	36	36
5	29	62	41	34	39

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

a) Reduce the following game by dominance property and solve it.

	1	2	3	4	5
I	1	3	2	7	4
II	3	4	1	5	6
III	6	5	7	6	5
IV	2	0	6	3	1

b) During a slack period, part of an assembly line is to be shut down for repair of a certain machine, while the machine is turned down the area will be painted construct a network for this machine rebuilding project based on the activity list furnished by the line for man as shown :

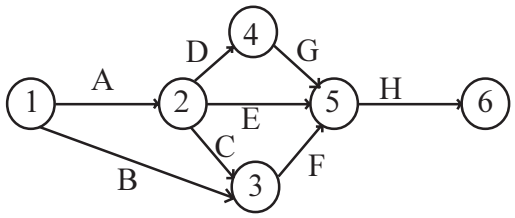
Activity	Activity Description	Restriction
A	Order new parts	A < B
B	Reassemble machine	B < E, I
C	Tear out foundation	C < G
D	Dismantle machine	D < C, F, A.
E	Paint area	E < I
F	Delivery parts to be repaid	F < H
G	Build New Foundation	G < B
H	Pick up repaired parts	H < B
I	Clean - up	–

c) A small project consting of eight activities has the following characteristics and the network diagram for the given data is given as follows :

Time Estimates :

Activity	Most Optimistic time (a)	Most likely time (m)	Most Pessimistic time (b)
A	2	4	12
B	10	12	26
C	8	9	10
D	10	15	20
E	7	7.5	11
F	9	9	9
G	3	3.5	7
H	5	5	5

PERT Diagram :



i) Prepare activity schedule for the project.

ii) Determine critical path.

d) Write atleast four distinctions between PERT and CPM.

e) Define the following :

i) Objective coefficient ranges.

ii) Sensitivity.

iii) Range of optimality

iv) Shadow price.

♦♦♦♦

Total No. of Questions : 5]

SEAT No. : ____

P905

[Total No. of Pages : 2

[4141] - 504

M.Sc. Tech. (Sem. - 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) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***

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

a) State the role of scheduler used in system kernel.

b) Explain the working of free list of buffers maintain by kernel.

c) Write a note on U area.

d) Define expansion swap.

e) Explain the use and syntax of setuid.

f) What is a role of disk driver?

g) State the various parameters of ptrace system call.

h) Explain any four options of RPM command.

i) Write a note on region.

j) State the significance of pid and sets of processes if pid is positive integer, pid is zero, pid is –1 and pid is negative integer but not –1.

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

i) What is context switch? Explain the steps for context switch.

ii) How to create a process? State the sequence of operations for fork().

P.T.O.

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

i) State the role of valid, reference, modify, Age and copy on write bit fields to support demand paging.

ii) Explain the role of file table and the user file table kernel data structures.

iii) List out the advantages and disadvantages of buffer cache.

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

i) Write a note on fork swap.

ii) How kernel handles the interrupt.

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

i) Write a note on bootstrap procedure.

ii) What are the functions of line discipline?

iii) Write a note on socket model.

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

i) Write a note on signal Handling.

ii) Explain the role of page stealer process.

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

i) Explain any five fields of process table.

ii) Write a note on shell.

iii) What is service in linux? Explain start, stop, restart and chk.config commands.

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

i) Explain the various cases in which kernel can remove the entries for sticky-bit text regions.

ii) Give the syntax for msgget, msgsnd and msgrcv system calls.

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

i) Write a note on mapping virtual addresses to physical addresses.

ii) Explain the five states during page fault.

iii) State and explain any five fields of disk inodes.

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Total No. of Questions : 5]

SEAT No. :

P883

[Total No. of Pages : 4

[4141] - 101
M.Sc. Tech.
MATHEMATICS
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 101 : Real Analysis
(Sem. - 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: **[8 x 2 = 16]**

a) For $x \in R$ and $y \in R$, define

$$d(x,y) = \left| x^2 - y^2 \right| .$$

Determine if $d(x,y)$ is a metric or not.

b) Give an example of an open cover of the segment (0,1) which has no finite subcover.

c) Construct a bounded set of real numbers with exactly three limit points.

d) A metric space is called 'separable' if it contains a countable dense subset. Show that R^2 is separable.

e) Does the convergence of the sequence $\{|S_n|\}$ imply the convergence of the sequence $\{S_n\}$? Justify.

f) Investigate the behavior (convergence or divergence) of

$$\sum_{n=1}^{\infty} a_n \text{ if } a_n = \left(\sqrt[n]{n} - 1\right)^n .$$

g) Let f be a continuous real function on a metric space X. Let Z (f) be the set of all $p \in X$ at which $f(p) = 0$. Prove that Z (f) is closed.

P.T.O.

h) Prove that $f(x)=|x|$ is not differentiable at 0. Is $g(x)=|x|^2$ differentiable at 0? Justify.

i) Find the radius of convergence of the series $\sum_{n=0}^{\infty}\frac{z^n}{n!}$ where $z\in C$.

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

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

i) Prove that if P is a limit point of a set E, then every neighborhood of P contains infinitely many points of E.

ii) Prove that compact subsets of metric spaces are closed.

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

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

ii) Let E be a subset of the metric space (X , *d*). Show that $\overline{E}$, the closure of E is a closed set in X.

iii) If P > 0 and α is real, then prove that $\lim_{n\to\infty}\frac{n^\alpha}{(1+P)^n}=0$.

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

i) Let k be a positive integer. Let $\{I_n\}$ be a sequence of k - cells in R^k such that $I_n \supseteq I_{n+1}$, $(n=1,2,3,.....)$. Show that $\bigcap_{n=1}^{\infty} I_n$ is non empty.

ii) Let $\sum_{n=1}^{\infty} a_n$ be a series of non zero real numbers.

If $\limsup_{n\to\infty}\left|\frac{a_{n+1}}{a_n}\right|<1$ then show that the series $\sum_{n=1}^{\infty} a_n$ converges.

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

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

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

iii) Let *f* be a continuous mapping of a compact metric space X into a metric space Y. Prove that *f* (X) is compact.

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

i) State and prove the fundamental theorem of calculus.

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

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

i) Let I = [0 , 1] be the closed unit interval. Suppose *f* is a continuous mapping of I into I. Prove that $f(x) = x$ for atleast one $x \in I$.

ii) Let *f* be defined by

$$f(x) = \begin{cases} x^2 \sin\frac{1}{x} & \text{if } x \neq 0 \\ 0 & \text{if } x = 0 \end{cases}$$

Prove that *f* is differentiable at all points $x \in \mathbb{R}$ but f' is not a continuous function.

iii) With usual notations, prove that if P^* is a refinement of P, then $L(P, f, \alpha) \leq L(P^*, f, \alpha)$.

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

i) Prove that a mapping *f* of a metric space X into a metric space Y is continuous on X if and only if $f^{-1}(V)$ is open in X for every open set V in Y.

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

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

i) If $C_0+\frac{C_1}{2}+.....+\frac{C_{n-1}}{n}+\frac{Cn}{n+1}=0$, Where C_0, C_1, ..., C_n are real constants, prove that the equation.

$C_0+C_1x+.....+C_{n-1}x^{n-1}+C_nx^n=0$ has atleast one real root between 0 and 1.

ii) Show that the sequence $\{f_n\}$ defined by $f_n(x)=\frac{x}{1+nx^2}$

$\forall x\in R, n=1,2,3,.....$ converges uniformly to a function f on R.

iii) Prove that if E is an infinite subset of a compact set K, then E has a limit point in K.

Total No. of Questions : 5]

SEAT No. :

P885

[Total No. of Pages : 3

[4141] - 103
M.Sc. Tech.
MATHEMATICS
Industrial Mathematics With Computer Applications
MIM - 103 : Discrete Mathematical Structures - I
(2008 Pattern) (Sem. - I)

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

Instructions to the candidates:

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

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

a) Show that $p \leftrightarrow q$ and $(p \rightarrow q) \wedge (q \rightarrow p)$ are logically equivalent.

b) Write the negation of the statement $\forall x(\mathrm{P}(x) \rightarrow \mathrm{Q}(x))$.

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

d) Show that if there are 30 students in a class, then at least two have last names that begin with the same letter.

e) State the De Morgan's laws in a Boolean algebra.

f) Construct a circuit that produces the output $(\overline{x+y})$.

g) State true or false : " $(Z^+, +)$ is a monoid". Justify your answer.

h) Is the poset { 2, 3, 4, 6} under divisibility a lattice? Justify!

i) Let X = {1, 2, 3}. Draw the Hasse diagram of $(\mathrm{P}(\mathrm{X}), \subseteq)$ where P (X) is the power set of X and $\subseteq$ represents the subset relation.

j) Define a complemented lattice.

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

i) Give an indirect proof of the statement : " If $n = a\ b$, where a and b are positive integers then $a \leq \sqrt{n}$ or $b \leq \sqrt{n}$".

ii) Test the validity of the following argument:

$\exists x(\mathrm{C}(x) \wedge \neg \mathrm{B}(x)),\ \forall x(\mathrm{C}(x) \rightarrow \mathrm{P}(x))$

$\therefore\ \exists x(\mathrm{P}(x) \wedge \neg \mathrm{B}(x))$.

P.T.O.

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

i) State the converse, contrapositive and inverse of the conditional statement :

"If it snows tonight, then I will stay at home".

ii) Let P (x) be the statement "$x = x^2$". If the domain consists of the integers, what are the truth values of :

A) P (0).

B) P (1).

C) P (–1).

D) $\exists x \mathrm{P}(x)$.

E) $\forall x \mathrm{P}(x)$.

iii) Use rules of inference to show that the hypothesis "Ram works hard", "If Ram works hard, then he is a dull boy", and "If Ram is a dull boy, then he will not get the job" imply the conclusion "Ram will not get the job".

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

i) In any lattice show that for all a , b , $c \in$ L;

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

ii) Show that a sublattice of a modular lattice is modular.

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

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

ii) Use K - maps to minimize the sum - of - products expansions:

$$xy\bar{z} + x\bar{y}z + x\bar{y}\bar{z} + \bar{x}yz + \bar{x}\bar{y}z.$$

iii) Define direct product of two semigroups. Show that the direct product of two semigroups is also a semigroup.

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

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

ii) Let (S , *) and (T , *') be monoids with identities e and e', respectively. If $f : \mathrm{S} \to \mathrm{T}$ is an isomorphism then prove that $f(e) = e'$.

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

i) Let B be a Boolean algebra. For $x, y, z \in$ B, Prove that:

A) If $y \wedge x = z \wedge x$ and $y \wedge x' = z \wedge x'$ then $y = z$.

B) If $x \wedge y = 1$ then $x = 1$ and $y = 1$.

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

$xyz + x\bar{y}z + x\bar{y}\bar{z} + \bar{x}yz + \bar{x}y\bar{z} + \bar{x}\bar{y}\bar{z}$.

iii) Let A = { 0, 1} and consider the free semigroup (A*, ·) generated by A. Define the following relation on A by $\alpha R \beta$ if and only if α and β have the same number of 1's.

Show that R is a congruence relation on (A* , ·).

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

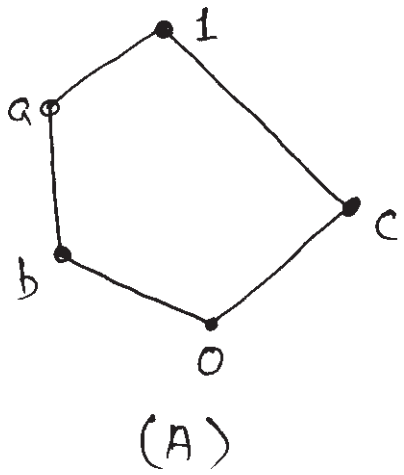
i) Show that among any $n + 1$ positive integers not exceeding Zn there must be an integer that divides one of the other integers.

ii) Using the principle of inclusion - exclusion find the number of primes between 1 and 100.

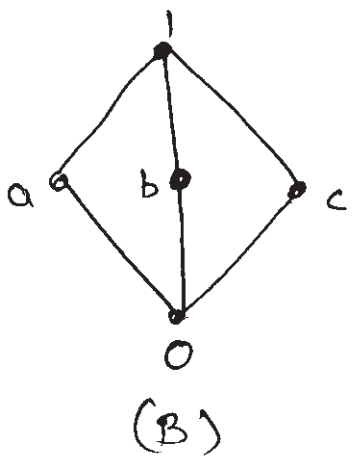
b) Attempt <u>any two</u> of the following: **[10]**

i) How many elements are in the union of four sets if the sets have 50, 60, 70 and 80 elements, respectively, each pair of the sets has 5 elements in common, each triple of the sets has 1 common element, and no element is in all four sets?

ii) Show that the following lattices are non-distributive.



(A)



(B)

iii) Let T be the set of all even integers. Show that the semigroups (Z , +) and (T , +) are isomorphic.

Total No. of Questions : 5]

SEAT No. :

P887

[Total No. of Pages : 2

[4141] - 105
M.Sc. Tech.
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 105 : Elements of Information Technology
(Sem. - 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) Define : Computer.

b) Define : RAM. State different types of RAM.

c) Give the octal representation of following decimal numbers.

i) 10

ii) 15.

d) Define : Operating system.

e) What is primary memory?

f) State special characters in files.

g) What is protocol? State its different types.

h) State different types of input devices.

i) What is ASCII code?

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

a) With suitable diagram, explain the basic structure of a computer.

b) What is world wide WEB (www)? Explain in detail.

c) Explain time sharing operating system.

d) Define Indexing. Explain different types of it.

e) Explain different applications of network.

P.T.O.

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

a) Explain different generations of computer. State features of 3rd generation computer.

b) Define software. Explain any 2 types of software.

c) State different types of printer. Explain any one of them in detail.

d) What is file organization? Explain sequential file organization in detail.

e) Write a note on multiprogramming operating system.

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

a) What is secondary memory? Explain the working of hard disk drive.

b) Write a note on EBCDIC code.

c) Explain the concept of communication and communication media.

d) Define topology. Explain star topology in detail.

e) Explain how an element is removed from dense index. Give suitable example.

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

a) In detail, explain tree structured indexing. Give advantages and disadvantages of it.

b) Explain different features and advantages of computer.

c) What is Information technology? Explain different features and advantages of it.

Total No. of Questions : 5]

SEAT No. :

P889

[Total No. of Pages : 3

[4141]-202
M.Sc. Tech.
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 202 : Algebra - II
(2008 Pattern) (Sem. - II)

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

Instructions to the candidates:

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

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

a) Let $P_2[x]$ denote the set of all polynomials of the form $a + bx + cx^2$, where a, b, c are real numbers. Show that $\{x^2 + x + 1, x^2 + x, x^2 + 1\}$ is a basis of $P_2[x]$.

b) Let V be a finite dimensional vector space and $T : V \to V$ be a linear transformation. Show that T is a one-one linear transformation if and only if T is onto.

c) Consider $e_1 = (1, 0), e_2 = (0, 1) \in R^2$ with usual inner product. Compute the angle between $e_1 + 3e_2$ and $3e_1 - e_2$.

d) If $\{v_1, v_2, ..., v_n\}$ is an orthonormal set in an inner product space V, then it is a linearly independent set in V.

Is this statement true or false? Justify.

e) Find the eigenvalues and the corresponding eigenvectors of the matrix

$$A = \begin{bmatrix} 2 & 0 \\ 0 & -13 \end{bmatrix}$$

f) Give an example of an algebraic extension of Q which is not a finite extension.

g) Show that every extension of degree 2 is a normal extension.

h) Give an example of an inseparable extension.

i) Determine the splitting field of the polynomial $x^4 - 1 \in Q[x]$.

j) Show that $Z[x]$ is a Z-module.

P.T.O.

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

i) Let V be a finite dimensional vector space over a field F. Show that any two bases of V have same number of elements.

ii) Let V be an inner product space. For any two vectors, $\alpha, \beta \in V$, prove that $|\langle \alpha, \beta \rangle| \leq \| \alpha \| \| \beta \|$.

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

i) Let $T : P_1 \to R^2$ be function defined by the formula $T(p(x)) = (p(0), p(1))$.

1) Show that T is a linear transformation.

2) Show that T is one-one and onto.

3) Find T^{-1}.

ii) Let $A = \begin{bmatrix} 0 & 0 & 2 \\ 0 & 2 & 0 \\ 2 & 0 & 3 \end{bmatrix}$. Find the characteristic polynomial of A.

Find the eigenvalues of the matrix A. Also, find an eigenvector corresponding to largest eigenvalue.

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 **any one** of the following : **[6]**

i) Let W_1, W_2 be finite dimensional subspaces of a vector space V. Prove that

$$\dim(W_1) + \dim(W_2) = \dim(W_1 + W_2) + \dim(W_1 \cap W_2).$$

ii) Let M, N be left R-modules and $f : M \to N$ be an onto homomorphism. If K is kernel of f then prove that K a left R-module. Further, show that M/K is isomorphic to N as R-modules.

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

i) Apply Gram-Schmidt process to obtain an orthonormal basis from $\{(1, 0, 1), (1, -1, 0), (1, 1, 1)\}$.

ii) Find a basis for the null space and row space of

$$A = \begin{bmatrix} 1 & 4 & 5 & 6 & 9 \\ 3 & -2 & 1 & 4 & -1 \\ -1 & 0 & -1 & -2 & -1 \\ 2 & 3 & 5 & 7 & 8 \end{bmatrix}$$

iii) Let T : $R^3 \to R^4$ be a linear transformation. Show that T cannot be an onto transformation. Also, show that there cannot be a one-one linear transformation from R^4 to R^3.

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

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

ii) Let F be a field and $f(x) \in F[x]$ be a non-constant polynomial. Prove that there exists an extension E of F which contains a root of $f(x)$.

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

i) Let F be a finite field of characteristic p. Define $\phi : F \to F$ by $\phi(a) = a^p$. Show that ϕ is an automorphism of F.

ii) Prove that if $\alpha \in E$ is algebraic over F of an odd degree then show that $F(\alpha) = F(\alpha^2)$.

iii) If L/K and K/F are normal extension then is it true that L/F a normal extension? Justify.

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

i) Prove that the non-zero elements of a finite field F is a cyclic group under multiplication.

ii) Prove that any algebraic extension of a finite field F is a separable extension.

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

i) Find the splitting field of $x^3 - 2$ over the field of rational numbers. Find its Galois group.

ii) 1) Show that $K = Q(\sqrt{3}, \sqrt{5})$ is an extension of degree 4. Further, show that $Q(\sqrt{3}, \sqrt{5}) = Q(\sqrt{3} + \sqrt{5})$. Also, show that K/Q is a separable extension.

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

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Total No. of Questions : 5]

SEAT No. :

P890

[Total No. of Pages : 5

[4141]-203

M.Sc. Tech. (Sem. - II)

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 203 : Discrete Mathematical Structure - II

(2008 Pattern)

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

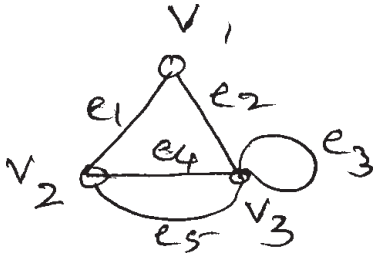
Instructions to the candidates:

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

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

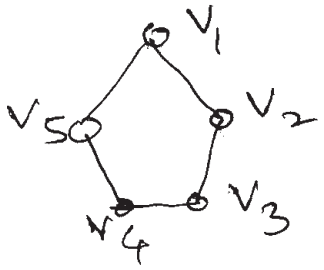
a) Define complete bipartite graph.

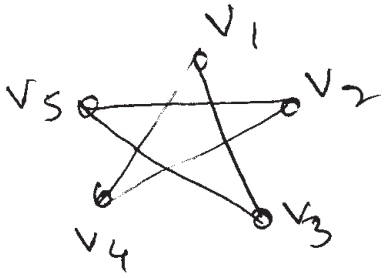
b) Explain Konisberg bridge problem.

c) If G = 

Find G–{V_3}.

d) Are following 2 graphs self complementary? Justify.

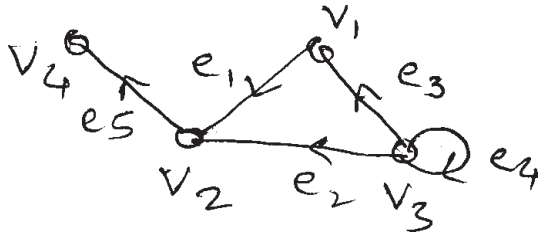




e) Define 'Symmetric diagraph'.

P.T.O.

f) For the following diagraph



Verify $\sum_{u \in V} d^{+}(u) = \sum_{u \in V} d^{-}(u)$.

g) Define chromatic number of a graph.

h) Justify whether following statement is true or false "A graph is planar if every proper subgraph of it is planar".

i) Prove that there is no simple graph with six vertices. One of which has degree 2, two have degree 3, three have degree 4 and remaining vertex has degree 5.

j) Define 'isthmus' and 'cut vertex'.

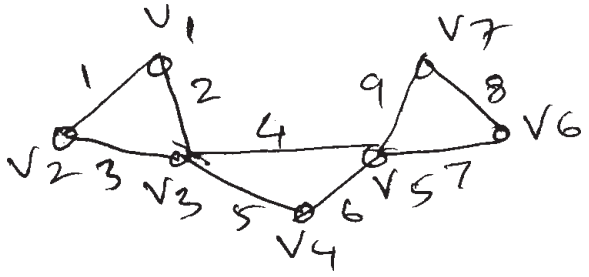
Q2) a) Attempt any <u>one</u> of the following : **[1 × 6 = 6]**

i) Prove that a graph G is disconnected if and only if its vertex set V can be partitioned into two nonempty disjoint subsets V_1 and V_2 such that there exists no edge in G where one end vertex is in subset V_1 and other in subset V_2.

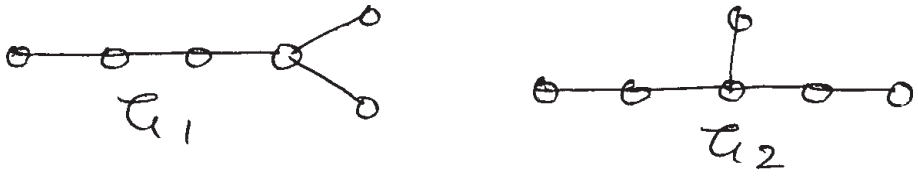
ii) Prove that "A connected graph G is an Euler graph if and only if it can be decomposed into circuits".

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

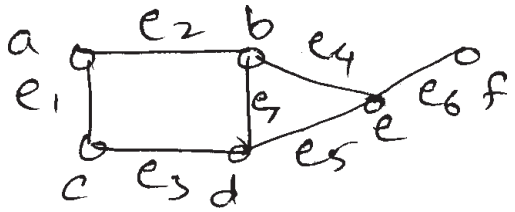
i) Using Fleury's algorithm find Euler line in following graph.



ii) Are following 2 graphs isomorphic? Justify.



iii) Find Adjacency and Incidence matrix for the following graph.



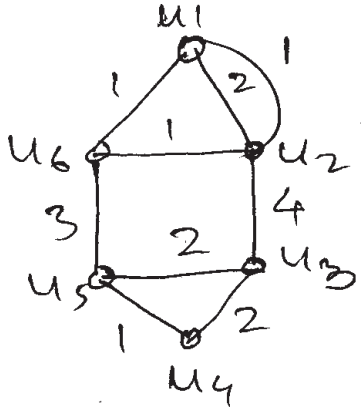
Q3) a) Attempt any <u>one</u> of the following : **[1 × 6 = 6]**

i) Prove that there are atleast 2 vertices of degree one in a tree with atleast two vertices.

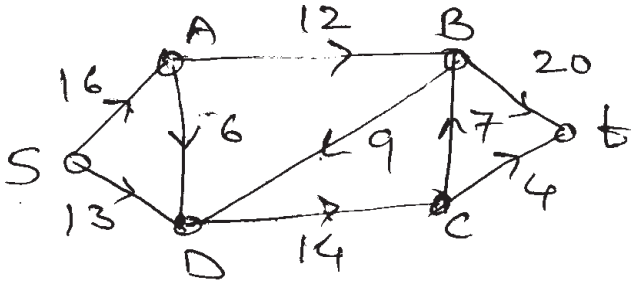
ii) Explain simple sequencial colouring algorithm for colouring a graph G.

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

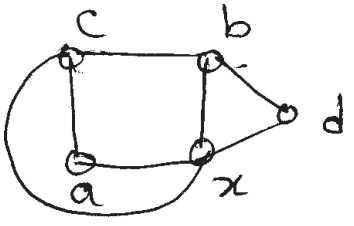
i) Using Kruskal's algorithm find minimum spanning tree of the following weighted graph G.



ii) Find maximum flow using Ford Fulkerson algorithm for graph G.



iii) Apply depth search algorithm for the following graph.



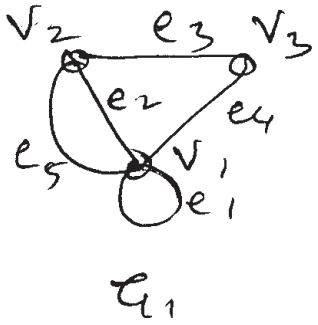
Q4) a) Attempt any <u>one</u> of the following : **[1 × 6 = 6]**

i) State and prove Euler's theorem for planar graphs.

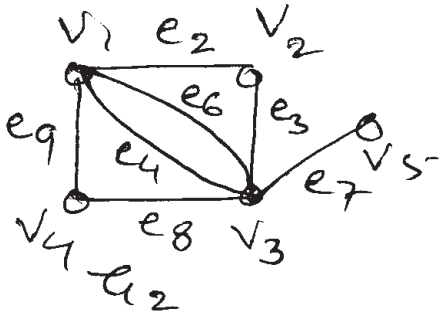
ii) Prove that 'the complete graph of five vertices is nonplanar'.

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

i) Find $G_1 \cup G_2$, $G_1 \cap G_2$ and $G_1 \oplus G_2$ of the following graphs G_1 and G_2.

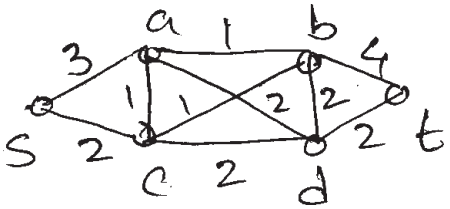


G_1



G_2

ii) Find shortest path in following weighted graph using Dijkstra's algorithm from *s* to *b*.



iii) Prove that a graph is bipartite if and only if all its circuits are even.

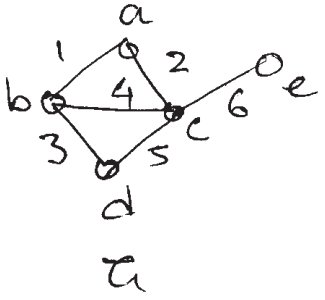
Q5) a) Attempt any <u>one</u> of the following : **[1 × 6 = 6]**

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

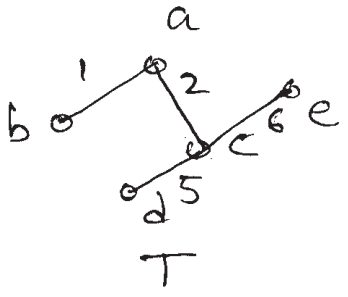
ii) Define binary tree. Prove that in a binary tree number of vertices *n* is always odd and number of pendant vertices is $\frac{n+1}{2}$.

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

i) Find all fundamental cutsets corresponding to spanning tree T



G



T

ii) Draw all non isomorphic trees on six vertices.

iii) Prove that in any simple connected planar graph with r regions, n vertices e edges, $e \geq \frac{3}{2}r,\ e \leq 3n-6.$

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Total No. of Questions : 5]

SEAT No. :

P891

[Total No. of Pages : 3

[4141]-204
M.Sc. Tech.
COMPUTER SCIENCE
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 204 : Database Fundamentals
(2008 Pattern) (Sem. - II)

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

Instructions to the candidates:

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

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

a) Give any 2 differences between file systems and database.

b) Define: Query in SQL.

c) Define : Entity.

d) Give any 2 operators of relational algebra.

e) What do you mean by mapping constraints?

f) What are joins?

g) Define: Primary key.

h) What are the functions of a DBA?

i) Give any 2 DML statements in SQL.

j) Define: Cursor.

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

a) What is the difference between generalization and specialization? Give an example.

b) Explain Aggregate functions in SQL.

c) What do you understand by attribute closure? Explain with an example.

d) Explain the concept of trigger in SQL.

e) Explain the architecture of DBMS.

P.T.O.

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

a) Explain the difference between Cartesian product and Natural join in relational algebra with an example.

b) Find the following for the table given below.

i) $R \cup S$ ii) $R \cap S$ iii) S–R.

Table : R

S.No.	Dept.
S_1	Phyl
S_2	Psy
S_3	Chem
S_4	Jour

Table: S

S.No.	Dept.
S_{10}	Maths 1
S_3	Chem
S_{15}	Eng
S_{16}	Maths 2.

c) What is a Weak Entity set in an ER Model? How do you map Weak Entity from an ER Model to a Table Structure?

d) A set of FDs for the relation R {A, B, C, D, E, F} is $AB \rightarrow C$, $C \rightarrow A$, $BC \rightarrow D$, $ACD \rightarrow B$, $BE \rightarrow C$, $EC \rightarrow FA$, $CF \rightarrow BD$, $D \rightarrow E$. Find a minimum cover for this set of FDS.

e) Explain normalization and briefly explain its type.

Q4) Attempt any two of the following : **[2 × 8 = 16]**

a) Consider the following relation for published books :
Book (Book-title, Author-name, Book-type, list-price, author-affil, publisher)
author-affil refers to the affiliation of author. Suppose the following dependencies exist :

Book-title $\rightarrow$ Publisher, Book-type.

Book-type $\rightarrow$ list-price

Author-name $\rightarrow$ Author affil.

i) What Normal form is the relation in? Explain your answer.

ii) Apply normalization until you cannot decompose the relations further. State the reasons behind each decomposition.

b) Consider the following table :
Works (Pname, Cname, Salary)
Lives (Pname, Street, City)
Located-in (Cname, City)
Manager (Pname, Mgrname)

Write the SQL for the following :

i) List the names of the people who work for the company Wipro along with the cities they live in.
ii) Find the persons who do not work for 'Infosys'.
iii) Find the persons whose salaries are more than that of all the 'oracle' employees.
iv) Find the persons who live and work in the same city.

c) Draw an ER diagram for a railway reservation system having the following information.

i) The train starts from a city station identified by the station - ID.
ii) Each train has a train-number, a name and mentions the number of seats available in three classes of service and the number of compartments assigned to each class.
iii) Each train has a route which consists of a series of station.
iv) Based on the types of reservation, there is a fixed fare between each pair of stations along the route.
v) The types of reservation depends on the day of the week on which the train operates.
vi) The train has a scheduled arrival and departure time for each station.
vii) During reservation, the customer name, phone number and address are recorded.
viii) The reservation provides a seat number/sleeper-number.

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

a) Write a note on : Data Models in R

b) Explain Aggregation in ER Model.

c) Define :

i) Super Key
ii) Foreign Key
iii) Composite Key
iv) Candidate Key.

d) Write a note on : Nested Query with an example.

e) Explain functional dependency in Relational algebra.

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Total No. of Questions : 5]

SEAT No. :

P892

[Total No. of Pages : 2

[4141] - 205
M.Sc. Tech.
Industrial Mathematics With Computer Applications
MIM - 205 : Data Structures Using 'C'
(Sem. - II) (2008 Pattern)

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

Instructions to the candidates:

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

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

a) What is queue? Explain different operations can be performed on queue.

b) Define the term data structures.

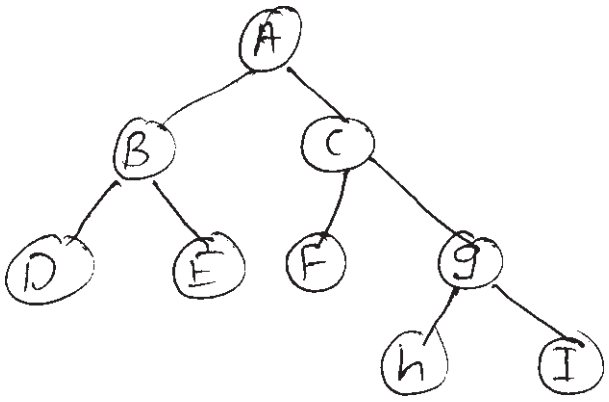
c) Describe the structure of linked list.

d) Write a note on 2-D arrays.

e) Convert the following infix expression to postfix.

C*D – A / E + (D – E) + B

f) Give the inorder traversal for the following tree:



g) Give the best case and worst case of bubble sort technique. Write with respect to Big O notation.

h) Define : indegree, out degree and total degree of the graph.

i) List and explain any two operations of the linked list.

j) Define : Priority queue and DEQUEUE

P.T.O.

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

a) Write a 'C' program to implement push and pop operations of stack using linked list.

b) Write a 'C' program to sort the 'n' elements of an array using recursive quick sort method.

c) Write a 'C' program to implement graph as an adjacency matrix.

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

a) Write a note on Round Robin CPU scheduling algorithm.

b) Explain linear and nonlinear data structures with suitable examples.

c) Write a note on array as ADT.

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

e) Write a function to insert a node in the singly linked list "at end".

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

a) Evaluate the following postfix expression using stack. Also give the contents of stack.

653 + g * + .

b) Write a note on inserting a node in to binary search tree.

c) What do you mean by "queue is full" and "queue is empty" conditions? Write a code to test these conditions (use function).

d) Write a algorithm to implement BFS.

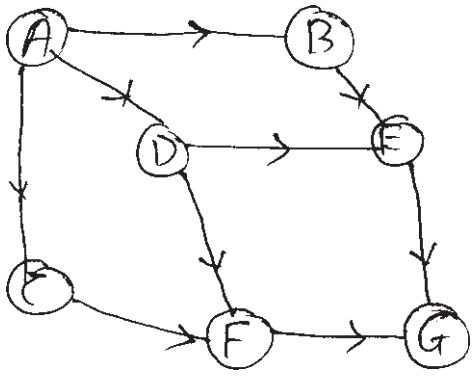
e) Discuss the time complexity of quick sort algorithm in average case.

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

a) Write a function to search an element in the given list of integer using linear search technique.

b) Discuss the timecomplexity to search an element in the array.

c) Traverse the following graph using DFS.



d) Write a note on circular queue.

e) Explain the static implementation of binary tree using arrays.

Total No. of Questions : 5]

SEAT No. :

P893

[Total No. of Pages : 4

[4141]-301

M.Sc. Tech.

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS

MIM - 301 : Numerical Analysis

(2008 Pattern) (Sem. - III)

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

Instructions to the candidates:

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

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

a) Obtain a root of $x^3 - 3x - 5 = 0$ using bisection method correct upto three decimal places.

b) State Newton's general interpolation formula with divided difference.

c) Examine for consistency the following system of equations

$2x - 3y + 5z = 1$

$3x + y - z = 2$

$x + 4y - 6z = 1$.

d) Find the n^{th} difference of e^x.

e) When the system of equations becomes ill-conditioned?

f) Find the inverse of the following matrix

$$\begin{bmatrix} 1 & 6 & 4 \\ 0 & 2 & 3 \\ 0 & 1 & 2 \end{bmatrix}.$$

g) Obtain a real root of the equation $\cos x = 3x - 1$ using the iteration method correct upto three decimal places.

h) Compute A^4 where $A = \begin{bmatrix} 1 & -2 \\ 3 & 4 \end{bmatrix}$.

i) State Fourth order Runge-Kutta formula.

P.T.O.

j) Find the rank of the following matrix

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 8 \\ 3 & 2 & 1 \end{bmatrix}$$

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

i) Obtain the Newton-Raphson Formula to find the root of the equation $f(x) = 0$. Show that this method has a quadratic convergence.

ii) Suppose $y(x)$ is a continuous function which is $(n + 1)$ times differentiable in the interval (a, b). Given the $(n + 1)$ points (x_0, y_0), (x_1, y_1), ..., (x_n, y_n), Find Lagrange's polynomial $L_n(x)$ of degree n such that $L_n(x_i) = y(x_i) = y_i \quad i = 0, 1, ..., n.$

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

i) Determine the largest eigenvalue and the corresponding eigenvector of the matrix.

$$\begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}.$$

ii) Solve the system

$$5x - 2y + z = 4$$
$$7x + y - 5z = 8$$
$$3x + 7y + 4z = 10.$$

by Gauss-Jordan method.

iii) Evaluate $I = \int_0^1 \frac{1}{1+x} dx$

With $h = 0.25$ using Simpson's 1/3 rule.

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

i) Derive Newton-Cote formula for integration.

ii) Derive Simpson's $\frac{3}{8}$ rule for integration.

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

i) Establish the formula

$x_{i+1} = \frac{1}{2}\left[x_i + \frac{N}{x_i}\right]$ and hence compute the value of $\sqrt{2}$, correct upto 3 decimal places.

ii) Decompose the matrix $\begin{bmatrix} 5 & -2 & 1 \\ 7 & 1 & -5 \\ 3 & 7 & 4 \end{bmatrix}$ into the LU form.

iii) The following table of values of x and y is given

x	y
0	6.9897
1	7.4036
2	7.7815
3	8.1291
4	8.4510
5	8.7506
6	9.0309

Find dy/dx when $x = 1$.

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

i) Let $x = \xi$ be a root of the equation $f(x) = 0$ and let I be an interval containing the point $x = \xi$. Let $\phi(x)$ and $\phi'(x)$ be continuous in I, where $\phi(x)$ is defined by the equation $\phi(x) = f(x) + x$. If $|\phi'(x)| < 1$ for all x in I then prove that the sequence of approximations $x_0, x_1, .., x_n$ defined by

$$x_{n+1} = \phi(x_n)$$

Converges to the root ξ, provided the initial approximation x_0 is choosen in I.

ii) Discuss Modified Euler's Method.

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

i) Reduce the following matrix to the tridiagonal form by Householder's method.

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

ii) Using Newton's Forward difference formula, Find the sum

$S_n = 1^3 + 2^3 + ... + n^3$.

iii) Solve the following system of nonlinear equations by Newton-Raphson Method.

$x^2 + y = 11$

$y^2 + x = 7$

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

i) Discuss Crout's method to find LU decomposition of a given matrix.

ii) Let $f(x)$ be a polynomial of degree n. Then prove that the n^{th} difference of $f(x)$ is a constant and higher order differences are zero.

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

i) Prove that the third divided difference of $f(x) = \frac{1}{x}$ with arguments p,q,r,s is $-1/(pqrs)$.

ii) Applying Lagrange's formula, find a cubic polynomial which approximates the following data.

x	y
–2	–12
–1	–8
2	3
3	5

iii) A solid of revolution is formed by rotating about x-axis the area between the x-axis, the lines $x = 0$ and $x = 1$, and a curve through the points with the following co-ordinates.

x	y
0	1
0.25	0.9896
0.50	0.9589
0.75	0.9089
1.00	0.8415

Estimate the volume of the solid formed, V using Simpson's $\frac{3}{8}$ rule where

$$V = \pi \int_0^1 y^2 dx$$

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Total No. of Questions : 5]

SEAT No.:

P895

[Total No. of Pages : 2

[4141]-303
M.Sc.Tech
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 303 : Object Oriented Programming in JAVA
(2008 Pattern) (Sem. - III)

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

Instructions to the candidates:

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

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

a) What is polymorphism?
b) Define Encapsulation.
c) State the difference between a scrollbar and a scrollpane.
d) How to declare a two-dimensional array in java?
e) What are final classes? Explain its use.
f) How are 'this' and 'super' keywords used with constructor?
g) What is 'javac' tool? Explain its use.
h) What is the use of finally block?
i) What is the major difference between Linkedlist and Arraylist?
j) Explain :
   i) Event source.
   ii) Event listener.

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

a) What is an exception? Explain user defined exceptions with example.
b) Explain and compare abstract classes and interfaces.
c) What is a package? How are packages classified in java? Give a suitable example to define a package in java.
d) What are different access specifiers in java? Explain all.
e) Write a short note on Garbage collection.

Q3) Attempt Any Two of the following : **[16]**

a) Write a program to read a string from the user. Then, extract a portion of a string and print the extracted string. Assume that 'm' characters are extracted starting with the 'n^{th}' character. ["computer" : "Puter"] n^{th} char mchars.

P.T.O.

b) Write a program to accept details of a person name, address, age. Throw the exception if

i) Age is less than zero. "Negative not allowed.
ii) Age is between zero to eighteen "you are minor".

c) Create a GUI based program containing List box, Text box and label. List any 5 city names in the list box. When any name in the list box will be selected, show its reverse in the text box.

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

a) Define a class employee with employee number, employee name and employee salary. Derive two classes as 'Part Time' and 'Full Time' storing designation. Define appropriate functions to accept data from the user. Also define a function to compare salaries of employees. Show the employee's details having maximum salary from 'Part Time' and 'Full Time'.

b) Write a program to accept 'n' numbers from the user through command line argument. Store them in array, perform following operations on array and show the output.

i) Reverse array.
ii) Add all array elements and show the result.
iii) Find minimum and maximum of array.

c) Write a program to accept file names through command line arguments. Check if that file exists, if yes, then show file name with file size and file path. If file does not exists, show appropriate message.

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

a) Explain in brief any four features of Java Programming language.

b) What are the different types of variables in Java? Define the scope of variables.

c) For each of the following, write a single statement code :

i) To find a substring of a string.
ii) Find out length of a string.
iii) Check if string "Maharastra" ends with "tra".
iv) Compare two strings for their contents.

d) Explain the steps to be performed in java database connectivity using JDBC-ODBC bridge and explain why is a bridge needed to use the database.

e) Explain and compare method overloading and method overriding.

Total No. of Questions : 5]

SEAT No.:

P896

[Total No. of Pages : 4

[4141]-304

M.Sc.Tech

INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATION

MIM - 304 : Operating Systems

(2008 Pattern) (Sem. - III)

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) Give any 2 responsibilities of short-term scheduler.

b) Give any 2 advantages of multiprocessor system.

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

d) "Paging suffers from internal fragmentation". State whether true or false with proper justification.

e) List any two algorithms used for handling dynamic storage allocation problem.

f) List any four criteria for CPU scheduling.

g) Give any two services provided by operating system.

h) Define :

   i) Internal fragmentation.

   ii) External fragmentation.

i) Define the terms :

   - Job queue.
   - Ready queue.

j) Define critical section problem.

P.T.O.

Q2) a) Attempt Any One of the following : **[1 × 6 = 6]**

i) Consider the following snapshot of a system.

	Allocation				Max			
	A	B	C	D	A	B	C	D
P_0	0	0	1	2	1	0	1	2
P_1	1	0	0	0	1	7	5	2
P_2	1	3	5	1	2	3	5	5
P_3	0	3	2	2	0	6	5	2
P_4	0	0	1	4	0	6	4	6

Available			
A	B	C	D
1	5	2	0

Answer the following questions using Banker's algorithm :

- Find Need
- Is the system in a safe state?
- If a request from process P_1 arrives for (0, 4, 2, 0) can the request be granted immediately?

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

b) Attmept Any Two of the following : **[2 × 5 = 10]**

i) What is multithreaded programming? Explain the benefits of multithreaded programming.

ii) What is dining-philosophers problem? Explain how semaphore can be used as a solution for the same.

iii) Consider the following segment table.

Segment	Base	Length
0	219	600
1	2300	14
2	90	100
3	1327	580
4	1952	96

What are the physical addresses for the following logical addresses.

	S	D
1)	0	430
2)	1	10
3)	2	500
4)	3	400
5)	4	112

Q3) Attempt Any Four of the following : **[4 × 4 = 16]**

a) What is long-term scheduler? Give various jobs done by the long-term scheduler.

b) Explain various steps in DMA transfer.

c) 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 preemptive SJF.

d) Explain any two file allocation methods.

e) Explain the dual mode operation of the O.S. with suitable diagram.

Q4) Attempt Any Four of the following : **[4 × 4 = 16]**

a) Explain following h/w instructions.

i) Test and set.

ii) Swap.

b) Consider the following page reference string.

1, 2, 3, 4, 5, 3, 4, 1, 6, 1, 3, 5, 8, 9, 6

How many page faults would occur for the following page replacement algorithms with 4 frames.

i) Optimal.

ii) FIFO.

c) Write short note on Deadlock Recovery.

d) Explain in brief

i) Buffering.

ii) Caching.

e) Explain various states of process with suitable diagram.

Q5) Attempt Any Four of the following : **[4 × 4 = 16]**

a) Explain any two approaches for free space management.

b) Explain concept of shared pages.

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

d) Explain concept of Process Control Block (PCB).

e) Explain various multithreading models.

Total No. of Questions : 5]

SEAT No.:

P897

[Total No. of Pages : 3

[4141]-305
M.Sc.Tech.
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATION
MIM - 305 : Theoretical Computer Science
(2008 Pattern) (Sem. - III)

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

Instructions to the candidates:

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

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

a) Let X = {∈ , *a*, *ba*}, list strings of length 3 in X*.

b) Define Mealy machine.

c) Describe the language denoted by regular expression baa*b and give two strings that do not belong to the language.

d) Construct DFA for the language {*a*, *b*} with odd number of *a*'s.

e) Let G *bc* the grammar with production {S → abSc/A, A → cAd/cd}. Give a derivation of ababccddcc.

f) Define ID of Turing Machine.

g) DPDA is equivalent to NPDA. Justify.

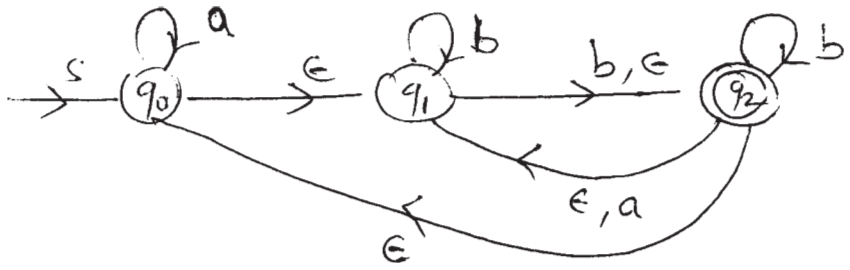
h) State pumping lemma for context free languages.

i) Show that grammar {S → aB/ab, B → *a*/b/aS} is ambiguous.

j) Define language accepted by PDA.

Q2) a) Attempt Any One of the following : **[6]**

i) For following ∈ -NFA compute ∈ -closure of each state and convert to equivalent DFA.



P.T.O.

ii) Construct minimized DFA for following DFA.

	δ	0	1
Start	A	B	F
	B	G	C
Final	C	A	C
	D	C	G
	E	H	F
	F	C	G
	G	G	E
	H	G	C

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

i) Construct NFA for following languages.

A) The set of strings over {*a*, *b*} whose third symbol is b.

B) The set of strings over {0, 1} which start with 0, ends with 1 or start with 1, ends with 0.

ii) Construct DFA which checks whether a binary number is divisible by 5 or not. Show that string 1111 is accepted.

iii) Construct FA for [(0 + 1)* (0 + 11) (1 + 0)* 1].

Q3) a) Attempt Any One of the following : **[6]**

i) State whether True or False and justify each of the following statement.

A) Complement of regular set is regular.

B) PDA accepts only regular languages.

C) CFL's are closed under concatenation.

ii) Design moore and Mealy machine for a binary input sequence such that if it has a substring "|0|" the machine outputs A, if it has a substring "110" machine outputs. B, otherwise it outputs C.

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

i) Show that L = {a^p/p is prime} is not regular.

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

iii) Explain Chomsky Heirarchy.

Q4) a) Attempt Any One of the following : **[6]**

i) Show that set of context free languages are closed under union but not under intersection.

ii) Convert following CFG to GNF.

$S \rightarrow AB/B$

$A \rightarrow BS$

$B \rightarrow A1/1$

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

i) Define useful symbol. Construct a grammar without useless symbol for following CFG.

$S \rightarrow AB/CA$, $B \rightarrow BC/AB$, $A \rightarrow a$

$C \rightarrow aB/b$, $D \rightarrow SS/d$.

ii) Convert following grammar to CNF.

$\{S \rightarrow aSa/bSb/a/b/aa/bb\}$

iii) Construct PDA that accepts language $L = \{ww^r/w \in (0+1)^*\}$ w^r is reverse of w.

Q5) a) Attempt Any One of the following : **[6]**

i) Construct CFG equivalent to PDA $M = (\{9_0, 9_1\}, \{a, b\}, Z, \delta, 9_0, \phi)$ where δ is

$\delta(9_0, a, Z) = (9_0, ZZ)$.

$\delta(9_0, b, Z) = (9_1, \in)$.

$\delta(9_1, b, Z) = (9_1, \in)$.

$\delta(9_1, \in, Z) = (9_1, \in)$.

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

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

i) Construct PDA which accepts a language. $L = \{a^n b^{2n+1} / n \geq 1)$.

ii) Explain Universal Turing Machine.

iii) Construct PDA equivalent to CFG $S \rightarrow aSa/bSb/a/b$.

Total No. of Questions : 5]

SEAT No.:

P898

[Total No. of Pages : 3

[4141]-401
M.Sc.Tech. (Sem. - 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) Write all the topologies on two element set.

b) Is the collection $J_\infty = \{U \mid X - U$ is infinite or all of $X\}$ a topology on X? Justify your answer.

c) Consider the set $y = [-1, 1]$ as a subspace of R, with standard topology on R. State whether the set $A = \left\{x \mid \frac{1}{2} < |X| < 1\right\}$ is open in Y? Is it open in R?

d) The following statement is true or false ! Justify your answer.

$\frac{1}{2}$ is limit point of a set $A = (0, 1] \subseteq R$.

e) The following statement is true or false! Justify your answer. Consider the subset of real line :

$Y = [0, 1] \cup (2, 3)$ in subspace topology; then both [0,1] and (2, 3) are closed as a subset of *Y*.

f) State the pasting lemma.

g) Show that the subspace $[a, b]$ of R is homeomorphic with [0, 1].

h) Show that $[0, \infty)$ is not a compact subspace of R with usual topology.

i) Define first and second countable spaces.

j) Show that the set of rationals Q is not a connected subspace of R with standard topology.

P.T.O.

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

i) If $\{T_\alpha\}$ is a collection of topologies on X, show that $\bigcap_\alpha T_\alpha$ is a topology on X. Is $\bigcup_\alpha T_\alpha$ a topology on X? Justify your answer.

ii) Show that subspace and product of a Hausdorff spaces is Hausdorff.

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

i) Let $f : A \to B$ and $g : C \to D$ be continuous functions. Let us define a map.

$f \times g : A \times C \longrightarrow B \times D$ as :
$(f \times g)(a \times c) = f(a) \times g(c)$
show that $f \times g$ is continuous function.

ii) Show that X is Hausdorff if and only if the diagonal $\Delta = \{x \times x / x \in X\}$ is closed in $X \times X$.

iii) Let $\{A_\alpha\}$ be the collection of subsets of X; then prove that, $\overline{\bigcup_\alpha A_\alpha} \supset \bigcup_\alpha \overline{A_\alpha}$, and give an example where equality fails.

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

i) Let X and Y be topological spaces, and let $f : x \to y$; be given map. Prove that following are equivalent :

a) f is continuous.

b) For every subset A of X, one has $f(\overline{A}) \subset \overline{f(A)}$.

c) For every closed set B of Y, the set $f^{-1}(B)$ is closed in X.

ii) Let $f : A \to X \times Y$ be given by the equation $f(a) = (f_1(a), f_2(a))$, $\forall\ a \in A$. Prove that f is continuous if and only if the functions $f_1 : A \to X$ and $f_2 : A \to Y$ are continuous.

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

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

ii) 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 $\bigcup_n$ An is connected.

iii) Show that every closed subspace of a compact space is compact.

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

i) Prove that the image of a connected space under a continuous map is connected.

ii) Show that, every compact subspace of a Hausdorff space is closed.

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

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

ii) Show that the set of rationals Q is not locally compact.

iii) Prove that a closed subspace of a normal space is normal.

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

i) Prove that every regular space with countable basis is normal.

ii) Prove that every metrizable space is normal.

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

i) Show that a finite union of compact sets is compact.

ii) Show that the space R_k is Hausdorff but not regular; where R_k denotes the real numbers in topology having basis as all open intervals (a, b) and all sets of the form (a, b) – K where $k = \left\{\frac{1}{n} | n \in Z_+\right\}$.

iii) Show that the unit ball $B^n = \{ \overline{X} / \| \overline{X} \| \leq 1 \}$ in R^n is path connected where $\| \overline{X} \| = \|(x_1, x_2, ... x_n)\| = (x_1^2 + x_2^2 + ... + x_n^2)^{1/2}$.

Total No. of Questions : 5]

SEAT No.:

P899

[Total No. of Pages : 2

[4141]-402
M.Sc.Tech
COMPUTER SCIENCE
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 402 : Computer Networks
(2008 Pattern) (Sem. - IV)

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) Define the following terms with suitable examples.
   i) Analog Signals.
   ii) Digital Signals.

b) What is the purpose of transport layer.

c) Compare Adaptive and Non-Adaptive routing.

d) Write a note on organization of the layers in ISO-OSI model.

e) Write a short note on implementation of the spanning tree bridges.

f) Explain sequence number and acknowledgement number fields of TCP segment header.

g) Explain flooding-static routing algorithm.

h) Define UTOPIA. Explain the sender and receiver side of UTOPIA.

i) Explain the basic model of FTP.

j) Show the NRZ-I and Rz encoding for the bit pattern 110011001.

Q2) a) Attempt Any One of the following : **[1 × 6 = 6]**
   i) Write a note on parallel transmission and serial transmission. Also draw suitable diagram.
   ii) What are the responsibilities of data link layer?

b) Attempt Any Two of the following : **[2 × 5 = 10]**
   i) Write a note on store and forward packet switching.
   ii) Explain the sender and receiver side of sliding window protocol.
   iii) Write a note on persistent and Non-persistent CSMA.

P.T.O.

Q3) a) Attempt Any One of the following : **[1 × 6 = 6]**

i) Write a note on coaxial cable.

ii) Explain the architecture of Bluetooth.

b) Attempt Any Two of the following : **[2 × 5 = 10]**

i) Differentiate between ISO-OSI and TCP/IP reference model.

ii) Write a note on Quantization.

iii) Explain the terms : boolean, seq _ nr, packet, frame kind and frame used in data link layer protocols.

Q4) a) Attempt Any One of the following : **[1 × 6 = 6]**

i) Write a note on 10 Base 2, 10 Base 5 and 10 Base T Ethernetcabling.

ii) What is subnet? How subnetting is performed using classful addressing scheme?

b) Attempt Any Two of the following : **[2 × 5 = 10]**

i) Write a note on bit stuffing and byte stuffing framing methods of DLL.

ii) How connection is released in transport protocol?

iii) Explain the communication over control and data connection in FTP.

Q5) a) Attempt Any One of the following : **[1 × 6 = 6]**

i) Explain with suitable example the manchester and differential manchester encoding techniques.

ii) Write a note on multiplexing.

b) Attempt Any Two of the following : **[2 × 5 = 10]**

i) Explain PAR protocol of DLL.

ii) Differentiate between virtual circuit and datagram.

iii) Describe the steps in making remote procedure call.

Total No. of Questions : 5]

SEAT No.:

P900

[Total No. of Pages : 2

[4141]-403
M.Sc.Tech. - II
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 403 : Web Technology
(2008 Pattern) (Sem. - IV)

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

Instructions to the candidates:

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

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

a) What are the two modes of the PHP processor?
b) List any two operations that are essential in web documents but that can not be done with HTML.
c) What are cookies? Where are they stored?
d) What is list and a list literal in perl?
e) Give two examples of WYSIWYG HTML editors.
f) Give two features of perl that make it ideal for CGI programming.
g) What are the two required attributes of an <img> tag?
h) What does the i pattern modifier do in Java Script? Give an example of the same.
i) Describe the meaning of the default attribute values # REQUIRED and # IMPLIED in XML DTD.
j) What are four scalar types of PHP?

Q2) Solve Any Four of the following : **[4 × 4 = 16]**

a) Differentiate between GET and POST methods of HTTP protocol.
b) What are character entities in HTML? Give any six commonly used entities with their meaning.
c) Give usage of following string methods in Java Script with suitable example.
   i) char At ( )
   ii) index of ( )
   iii) sub string ( )
   iv) touppercase ( )
d) Write short note on CGI.pm module.
e) What is servlet? What is servlet container?

P.T.O.

Q3) Attempt Any Four of the following : **[4 × 4 = 16]**

a) Explain the concept of status line and status code of HTTP response.
b) Explain creation of any two types of lists in HTML with suitable example.
c) Write a Java Script for finding square and square root of a number, accepted from user.
d) Explain XSLT processing with suitable diagram.
e) Describe use of substitute and transliterate operator in perl with suitable examples.

Q4) Attempt Any Four of the following : **[4 × 4 = 16]**

a) What is purpose of the doGet, doPost, doPut and doDelete methods of HttpServlet class? Describe the two parameters to doGet method.
b) Write a PHP script for finding sum and average of array elements. (Use function).
c) Give two different methods of array creation in Java Script. Give any two characteristics of an array object.
d) Explain concept of hashes in perl with suitable example.
e) What is a Web Server? What is document and server root of a web server?

Q5) Attempt Any Four of the following : **[4 × 4 = 16]**

a) Design an XML document with at least three instances to store information about patients in a hospital Information about patients must include name (first, middle, last), patient-id, age, room-no, Doctor-Name. (Both attributes and nested tags must be included).
b) Give use of following PHP functions
   i) asort.
   ii) ksort.
   iii) rsort.
   iv) arsort.
c) What potential advantages do servlet have over CGI program.
d) Write a perl program to count and display number of customers whose bill-amount is more than ₹.3000. Assume that the input to the program is a file customer.txt, containing customer data in following format-customer-name : bill-date : bill-amount.
e) Explain various tags used in HTML for table creation.

Total No. of Questions : 4]

SEAT No.:

P901

[Total No. of Pages : 3

[4141]-404
M.Sc.Tech. (Sem. - 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:

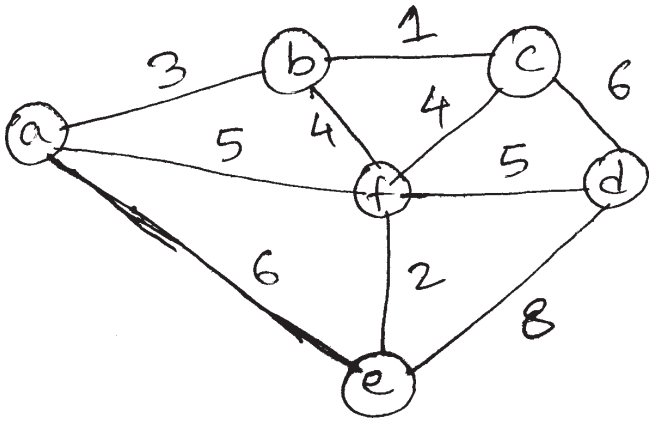
1) ***Figures to the right indicate full marks.***
2) ***All questions are compulsory.***

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

a) Show that $3n^2 + 2n$ is $O(n^2)$.
b) State master's theorem.
c) Define worst case and best case efficiency.
d) Define root node and leaf node.
e) What is Huffman coding?
f) Define minimum spanning tree.
g) Define directed a cyclic graph. (dag).
h) Justify whether the following array can be sorted using counting sort in linear time A = {1, 7, 36, 44, 3, 5}.
i) What is time complexity of depth first search algorithm.
j) Explain the process of relaxing an edge with an example.

Q2) Attempt Any Two of the following : **[2 × 10 = 20]**

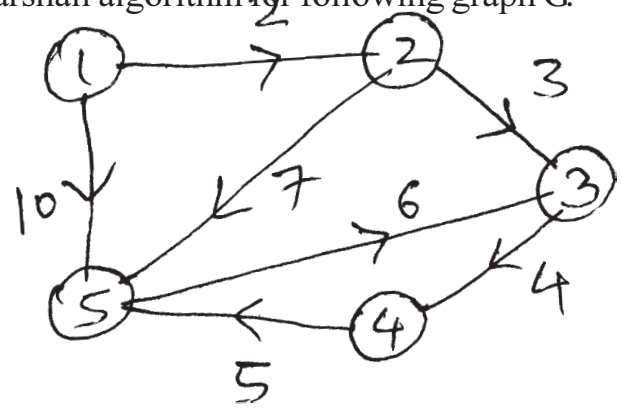
a) Write down prim's algorithm for fining minimum spanning tree for a given graph G. Hence find minimum spanning tree for following graph using Prim's algorithm.



P.T.O.

b) Write Quicksort algorithm for sorting given array of elements a [1..n]. What is its time complexity in average case? Sort following array using quick sort algorithm; {65, 70, 75, 80, 85, 60, 55, 50, 45}.

c) Given a weighted directed graph G = (V, E) with n vertices, explain all pairs shortest path algorithm. (Floyd-Warshall algorithm). Apply Floyd Warshall algorithm for following graph G.



Q3) Attempt Any Three of the following : **[3 × 8 = 24]**

a) Explain divide and conquer strategy. Explain mergesort algorithm. What is its time complexity?

b) What is dynamic programming? Explain principle of optimality. What is matrix multiplication problem? Give an algorithm for matrix multiplication.

c) Discuss travelling salesman problem? Is it NP complete?

d) Explain the activity selection problem and give a greedy algorithm for the same.

Q4) Attempt Any Four of the following : **[4 × 5 = 20]**

a) Consider the five character alphabet {A, B, C, D, –} with the following occurance of probabilities.

Character	A	B	C	D	–
Probability	0.35	0.1	0.2	0.2	0.15

Construct Huffman tree for this input. Encode 'ABBC'.

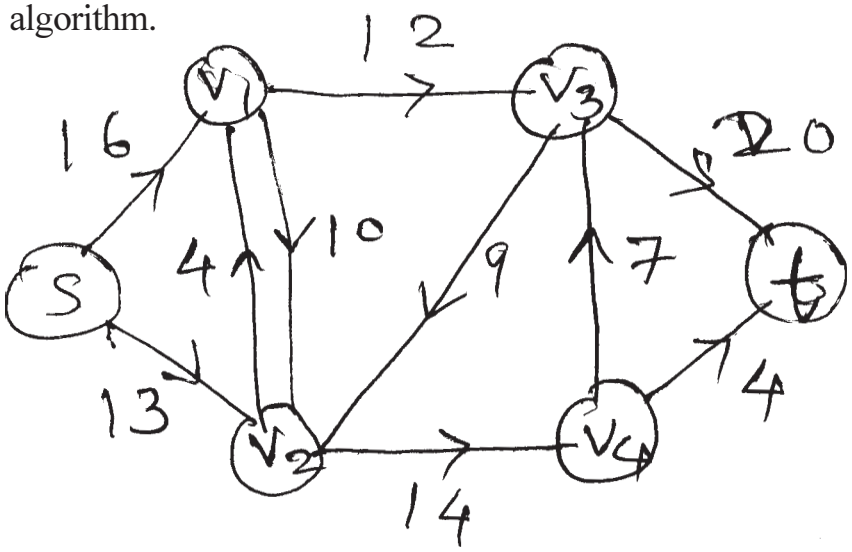
b) Rank following f^ns in their increasing order of growth rates.

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

c) Write a note on 'Topological sorting'.

d) Define 'NP complete' problems. Discuss NP complete and reducibility.

e) Find the maximum flow of the following network using Ford Fulkerson algorithm.



f) Explain briefly 'Bellman-Ford' algorithm for shortest path.

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Total No. of Questions : 5]

SEAT No. :

P903

[Total No. of Pages : 4

[4141] - 502
M.Sc. Tech.
INDUSTRIAL MATHEMATICS WITH COMPUTER APPLICATIONS
MIM - 502 : Numerical and Statistical Methods
(2008 Pattern) (Sem. - V)

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 x 2 = 16]**

a) Determine the probability that exactly one tail appears in the toss of 3 fair coins.

b) Suppose A and B are events with P(A) = 0.6, P(B) = 0.3 and $P(A \cap B) = 0.2$, find $P(A \cap B')$.

c) Find P(B/A) if A is a subset of B.

d) Define probability distribution of a discrete random variable.

e) State the pmf of Binomial distribution with parameters 10 and 0.2.

f) State the additive property of Poisson distribution.

g) Verify whether the following function can be considered as a pdf of a continuous random variable X:

$$f(x)=\begin{cases}6x(1-x), & 0\le x\le 1\\ 0, & \text{otherwise}\end{cases}.$$

h) Let X and Y be two independent normally distributed random variables with parameters (μ_1,σ_1^2) and (μ_2,σ_2^2) respectively. State the distribution of U = X + Y and V = X-Y.

i) Define Karl Pearson's Coefficient of correlation 'r'. State the limits of 'r'.

j) Given $r_{12} = 0.6$, $r_{13} = 0.4$, $r_{23} = 0.5$, calculate the multiple correlation coefficient $R_{1.23}$.

P.T.O.

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

a) State the classical definition of probability. Also state the axioms of probability.

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

c) Two men A and B fire at a target. Suppose P (A) = 1/3 and P (B) = 1/5 denote the probability of hitting the target. Assuming that the events A and B are independent, find the probability that

i) Both hit the target.

ii) At least one hits the target.

d) For the following probability distribution of X.

X	0	1	2	3
P (X = x)	k	2k	4k	3k

Find the value of k.

i) Evaluate P (X > 2).

ii) Evaluate E (X).

e) Let X $\rightarrow$ B (n,p). Given p = 0.6, E (X) = 6, find n, variance of X and P (X $\leq$ 1).

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

a) A discrete random variable has Poisson distribution with P (X = 0) = P (X = 1) = k. Find k and hence find P (X = 2).

b) The CDF of a continuous random variable X is

$$F(x)=\begin{cases} 0, & \text{if } x<0 \\ x^2/4, & \text{if } 0\leq x\leq 2 \\ 1, & \text{if } x>2 \end{cases}$$

Find PDF of X. Hence or otherwise find P (0.5 < X < 1).

c) State the pdf of continuous Uniform distribution over (a , b). Find its mean and variance.

d) The lifetime of a certain kind of battery is an exponential random variable with mean 400 hours. What is the probability that such a battery will last more than 200 hours? Also find the probability that the battery will last between 300 hours to 500 hours.

e) Describe a scatter diagram. Explain its utility in measuring the correlation between two variables.

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

a) Given the following information for a bivariate data:

$\bar{x}=53, \bar{y}=28, b_{yx}=-1.5, b_{xy}=-0.2,$ find the equations of the two lines of regression. Hence estimate Y for X = 55 and X for Y = 30.

b) Define the regression co-efficients b_{yx} and b_{xy}. State any two properties of the regression co-efficients.

c) The pdf of a continuous random variable X is given by,

$$f(x)=\frac{1}{2\sqrt{2\pi}}\, e^{-\frac{1}{2}\left(\frac{x-10}{2}\right)^2}, -\infty < x < \infty.$$

Identify the probability distribution of X. Hence find P (X > 12).

d) Explain the method of fitting the regression plane of X_1 on X_2 and X_3.

e) A random sample of size 16 is drawn from a population having Normal distribution. The sample mean and sample variance are given as 23.8 and 10.24 respectively. At 5% level of significance, test $H_0 : \mu = 25$ against $H_1: \mu \neq 25$.

Q5) Attempt any FOUR of the following: **[4 x 4 = 16]**

a) Calculate Karl Person's coefficient of correlation from the following information:

$\bar{x}=19, \bar{y}=7.9, n=10, \sum x^2=6360, \sum y^2=2860, \sum xy=3900$.

b) A survey was conducted to investigate whether alcohol drinking and smoking are related. The following information was compiled for 600 individuals:

	Smoker	Nonsmoker
Drinker	193	165
Nondrinker	89	153

Using 5% level of significance, test the null hypothesis that alcohol drinking and smoking are not related.

c) In a village A out of a random sample of 1000 persons 100 were found to be vegetarians. While in another village B out of 1500 persons 180 were found to be vegetarians. Do you find a significant difference in the food habits of people of the two villages. (Use $\alpha = 0.01$).

d) Define the following terms:

i) Null hypothesis.

ii) Critical region.

iii) Test statistic.

iv) One sided test.

e) Complete the following ANOVA table:

Source of variation	Degrees of freedom	Sum of squares	Mean sum of squares	F-Ratio
Between	3	?	?	?
Within	?	177.117	?	
Total	13	224.857		

Total No. of Questions : 5]

SEAT No. :

P904

[Total No. of Pages : 2

[4141] - 503
M.Sc. Tech. (Sem. - 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 x 2 = 16]**

a) State the use of pseudocolour image processing.

b) Define the digital image.

c) Define the term image restoration.

d) What is image histogram?

e) Give difference between radiance and luminance.

f) Give one application of thresholding.

g) Define TIFF and JPEG.

h) Define the texture of image.

i) What is 'Mean' and 'Standard deviation'?

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

a) Differentiate between Intensity and Spatial resolution.

b) Discuss the sampling and quantization of digital image.

c) Discuss the HIS model of digital image processing.

d) Write a short note on 'RGB model'.

e) Discuss with suitable diagram any one type of Image Acquisition device.

P.T.O.

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

a) What is Gamma correction? State its use in contrast control.

b) Explain with necessary diagram the histogram equalisation.

c) Discuss with suitable diagram the use of low pass filter for smoothing of digital image.

d) Discuss the Global thresholding algorithm.

e) Write a short note on 'Negative Image Enhancement technique'.

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

a) Discuss with suitable example the difference between Convolution and Correlation.

b) Discuss the medical application of image processing.

c) Explain the sharpening of image in frequency domain.

d) What is 'Noise'? Explain any one method of noise removal from the image data.

e) Write a short note on 'Biometric applications of digital image processing'.

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

a) Explain the detection method for

i) Point.

ii) Line.

iii) Edge.

b) Discuss in detail the elements of digital image processing.

c) Write a note on Fourier Transform and its applications in image processing.