

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 2nd Year 2nd Term Examination, 2017
 Department of Computer Science and Engineering
 CSE 2201

Algorithm Analysis and Design

TIME: 3 hours

FULL MARKS: 210

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

SECTION A

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

1. a) What is an algorithm? What are the basic criteria that an algorithm must satisfy? (10)
 b) Describe the steps in applying dynamic programming strategy when developing an algorithm. (10)
 c) Draw the recursion tree for $T(n) = 4T(n/2) + cn$, where c is a constant. Provide a good asymptotic upper bound on its solution and verify your bound by substitution method. (15)
2. a) Write down the best Big-oh (O) characterization for each of the following running time estimates of different algorithms. (12)
 - i) $1000n^2 + 16n + 2^n$
 - ii) $\log(n) + 10000$
 - iii) $50n + n \log(n^2) + 1000 \log(n)$
 - iv) $2^{20} + 3^7$
- b) Write pseudo code for a backtracking algorithm to solve m coloring problem. (10)
 c) What are the differences between performance analysis and performance measurement of an algorithm? (07)
 d) What are the differences between branch-and-bound and backtracking paradigm? (06)
3. a) Consider a 0/1 knapsack problem where knapsack capacity (m) = 10, weight = {10, 3, 5} and profit = {40, 20, 30}. Now explain the application of dynamic programming and greedy algorithm to find an optimal solution. (10)
 b) Consider a sum of subset problem with six items ($n = 6$) and $sum(m) = 30$. The items are $w[1:6] = \{5, 10, 12, 13, 15, 18\}$. Now draw a state space tree for the above problem using backtracking approach. (10)
 c) Explain how the solution space is reduced from N^N to $N!$ in N -Queen problem. (09)
 d) What do you mean by approximation algorithm? Why do we need approximation algorithm? (06)
4. a) Write the features of a divide and conquer paradigm. How will you compute time complexity of a divide and conquer paradigm? (10)
 b) What do you mean by greedy choice property? What are the characteristics of the optimization problem, in the context of greedy algorithm? Write down an algorithm for solving fractional knapsack problem using greedy method. (10)
 c) Consider the following table where p is the probability and k is the key value. Construct Optimal Binary Search Tree (OBST). (15)

k	1	2	3	4	5
$p(k)$	0.25	0.20	0.05	0.20	0.30

SECTION B

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

5. a) What is the pre-condition? Write down the pre-condition of Bellman-Ford algorithm and explain. (07)
 b) In scheduling independent tasks problem, let the number of processor, $m = 3$, number of tasks $n = 7$, where $(t_1, t_2, t_3, t_4, t_5, t_6, t_7) = (5, 2, 2, 4, 3, 5, 3)$. Schedule the tasks by Longest Processing Time (LPT) rule and then find the time difference between LPT scheduling and optimal scheduling. (13)

- c) What is topological sort? The directed graph given in Fig. 5(c) shows the prerequisite relation (15) among courses of different semesters. Give a linear ordering of nodes of the graph showing visiting time and finishing time for each node. Draw your own opinion about whether it is possible to give a linear ordering of nodes if a new directed edge is inserted in the graph from the node CSE 4205 to CSE 2173.

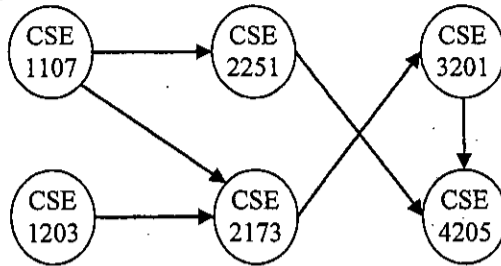


Fig. 5(c)

6. a) What is spanning tree? Consider the following undirected graph where the value of each edge (13) represents the length of that edge in Fig. 6(a). Apply Prim's algorithm.
 i) What is the length of the shortest path between A and D?
 ii) What is the length of the edges in a minimum spanning tree?

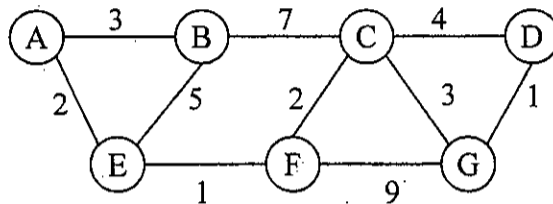


Fig. 6(a)

- b) What is Lower Bound? Derive a Lower Bound for three elements insertion sort using (15) comparison tree.
 c) Define Least Cost (LC) search. How LC search can be converted into BFS and DFS? (07)
7. a) Define NP-hard and NP-Complete problems using example(s). (07)
 b) Justify the statement – "All P problems are always NP". (10)
 c) Explain bin packing problem. Provide an example. For a bin size, $B = 10$, pack the bins with (18) the following weighted items.

Items	7	2	5	1	9	4	3	6
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Follow:

- i) First Fit
- ii) Best Fit
- iii) Next Fit

8. a) What do you understand by max-flow network? (05)
 b) What are the differences between Ford-Fulkerson and Edmonds-Karp algorithm? Apply Ford-Fulkerson algorithm for the network in Fig. 8(b). (20)

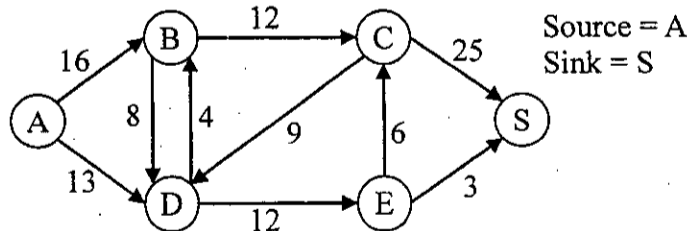


Fig. 8(b)

Find (i) Max flow (ii) Min cut.

- c) Find the shortest path from the following graph in Fig. 8(c) by using Bellman-Ford algorithm. (10)

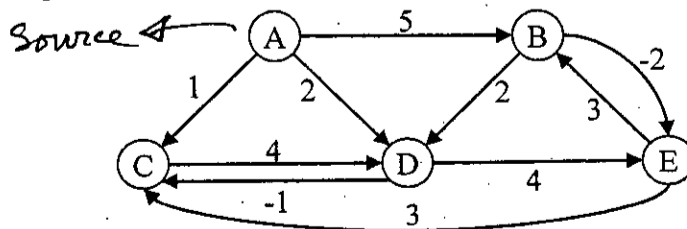


Fig. 8(c)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 2nd Term Examination, 2017
Department of Computer Science and Engineering
CSE 2203
Microprocessors and Microcontrollers

TIME: 3 hours

FULL MARKS: 210

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

SECTION A

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

1. a) Which feature of microprocessor determines the size of it? (06)
b) Define segmentation. Write down some benefits of segmentation in 8086 architecture. (07)
c) What are the methods of addressing in 8086 microprocessor? Use MOV instruction to illustrate different types of addressing modes. (12)
d) Describe the function of the 8086 queue. How does the queue speed up processing? (10)
2. a) What is the advantage of using assembly language instead of writing a program directly in machine language? Explain. (06)
b) What is the difference between unconditional jump and conditional jump instruction? (11)
Consider the following delay loop.
MOV CX, 600H
DLY: DEC CX
NOP
JNZ DLY
i) How many times the JNZ DLY instruction will execute?
ii) Change the program so that JNZ DLY is executed 120 times.
c) Construct the binary code for each of the following instructions. (10)
i) AND BL, 0AH
ii) MOV AX, [CX]
iii) IN AL, F0H
d) The loop instruction decreases the CX register but does not affect the zero flag – justify the statement with example(s). (08)
3. a) Compare the following instructions. (10)
i) REP and LOOP ii) STC and STD
iii) JMP and JB iv) ROL and RCL
b) Calculate the value of N for the following code which generates 5 seconds delay if 8086 system frequency is 4 MHz. (10)

```
MOV BX, N ; clock cycles
REPEAT: MOV CX, AFF0H ; 04
BACK : DEC CX ; 02
      JNZ BACK ; 16/4
      DEC BX ; 02
      NOP ; 03
      JNZ REPEAT ; 16/4
```

- c) Define the terms: (i) State, (ii) Machine cycle, (iii) Instruction cycle. (06)
d) Write down the functions of condition and control flags of 8086 microprocessor. (09)
4. a) What are the significances of reentrant procedure and recursive procedure? Explain with proper illustrations. (08)
b) Show with a net sketch the procedure of calculating the physical address of 8086 microprocessor. (07)
c) What is Direct Memory Access (DMA) data transfer? Briefly describe DMA data transfer with figure. (10)

- d) Use a stack map to show the effect of each of the following instructions on the stack pointer (10) and on the contents of the stack.

```

MOV SP, 1000H
PUSH AX
CALL STRING
POP AX

STRING PROC NEAR
PUSHF
PUSH AX
PUSH CX
    ⋮
POP CX
POP AX
POPF
RET
STRING ENDP

```

SECTION B

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

5. a) What are the basic differences between microprocessor and microcontroller? (06)
 b) Convert the following floating point binary number into decimal number form: (07)
 11000001110010010000000000000000
 c) How 16,384 segments \times 65,536 bytes/segment or about 1Gbyte of logical or virtual address space can be achieved using Memory Management Units (MMUs) in 80286, 80386 and 80486? Explain with necessary figure(s). (12)
 d) How does MMU manage segment based virtual memory? (10)
6. a) What are the conditions of stack in 8087 after performing following operations sequentially? (08)
 i) After reset.
 ii) Performs 5 PUSH operations.
 iii) Performs 2 POP operations.
 iv) Performs 3 PUSH operations.
 b) How do 8086 and 8087 execute their respective instructions? (08)
 c) Write the steps of switching the 80286 to protected address mode from real address mode operation. (09)
 d) Write down the limitations of 80286. How does 80386 overcome this? (10)
7. a) Briefly describe the functions of each bit of SCON register in 8051 μ C. (08)
 b) Suppose interrupts INT0, TF0 and INT1 of 8051 μ C activated at the same time. Assume that after reset, the interrupt priority is set by the instruction "MOV IP, #00001100B". Discuss the sequence in which the interrupts are serviced after setting this value to IP register of 8051 μ C. (09)
 c) Why memory must be specially managed in a multitasking operating system? Briefly describe Overlays and Bank switching method for memory management using necessary figure(s). (12)
 d) Describe the Internal on chip RAM organization of 8051 μ C with proper diagram. (06)
8. a) Why is interrupt flag (IF) automatically cleared as a part of response of 8086 to an interrupt? (06)
 b) How many 8259A will require to process 64 interrupt signals? Show with necessary figure. (10)
 c) How can 64TB of logical or virtual address space be achieved in 80386 by using MMU and segmentation? Explain with necessary figure(s). (12)
 d) Write short notes on serial port interrupt in 8051 μ C. Also explain the dual role of Port 0 and Port 3 in 8051 μ C. (07)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 2nd Year 2nd Term Examination, 2017
 Department of Computer Science and Engineering
 CSE 2207

Numerical Methods

TIME: 3 hours

FULL MARKS: 210

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

SECTION A

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

1. a) What is numerical computing? Write applications of numerical computing. (07)
- b) Write underlying methodology of bisection method. Hence find a root of the equation (13)
 $x^2 - 3x - 10 = 0$ using this method.
- c) Derive Newton-Raphson method from Taylor's series expansion. Write down the limitations (08)
 of Newton-Raphson method.
- d) Prove that Newton-Raphson method has quadratic convergence. (07)

2. a) Define interpolation with example. Derive Lagrange interpolation formula and hence derive (12)
 linear interpolation formula.
- b) Consider the following data: (10)
 $\sin 45^\circ = 0.7071, \sin 50^\circ = 0.7660$
 $\sin 55^\circ = 0.8192, \sin 60^\circ = 0.8660$
 Find $\sin 52^\circ$ by using Lagrange interpolation polynomial.
- c) What are the advantages of Newton interpolation over Lagrange interpolation? Derive (13)
 Newton interpolation formula.

3. a) Derive Gregory-Newton forward difference formula. Using this formula estimate the value (15)
 of $\ln(3.5)$ for the following data:

x	1.0	2.0	3.0	4.0
$\ln(x)$	0.0	0.6931	1.0986	1.3863
- b) What is regression and least square regression? Use least square regression to fit a straight (10)
 line to the following data:

x	1	3	4	6	8	9	11
y	1	2	4	4	5	7	8

 Along with slope and intercept, calculate the standard error.
- c) Discuss least square regression technique for transcendental equations. (10)

4. a) Define the terms: (i) characteristics matrix, (ii) characteristics polynomial, (iii) Eigen (10)
 value, (iv) Eigen vector.
- b) Define initial value problem and boundary value problem with example(s). (05)
- c) What is Fadeev-LeVerrier method? Using this method, find the characteristics polynomial of (12)
 the following system.

$$2x_1 + 8x_2 + 10x_3 = \lambda x_1$$

$$8x_1 + 3x_2 + 4x_3 = \lambda x_2$$

$$10x_1 + 4x_2 + 7x_3 = \lambda x_3$$
- d) Find the largest Eigen value and corresponding Eigen vector of the following coefficient (08)
 matrix.

$$\begin{bmatrix} -13 & 3 & -5 \\ 0 & -4 & 0 \\ 15 & -9 & 7 \end{bmatrix}$$

SECTION B

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

5. a) What is a partial differential equation? Give an example. (06)
- b) What is Crank-Nicholson method? (05)
- c) Derive the five-point formula for Laplace's equation. (12)
- d) Consider a steel plate of size $15\text{cm} \times 15\text{cm}$. If two of the sides are held at 100°C and the other (12)
 two sides are held at 0°C , what are the steady-state temperature at interior points assuming a
 grid size of $5\text{cm} \times 5\text{cm}$?

6. a) What is numerical integration? Explain with example. (08)
- b) Derive general quadrature formula for equidistant ordinates and from there draw the equation for Simpson's $\frac{3}{8}$ rule. (13)
- c) Integrate $\int_4^{5.2} \tan x dx$ by Simpson's $\frac{1}{3}$ rule. Compare the result with the standard value. (14)
7. a) Write the differences between homogeneous system of equations and non-homogeneous system of equations. (08)
- b) Suppose a matrix A will be factorized into L and U as follows: $A = LU$. Then find the equation for L and U. (12)
- c) Use Runge-Kutta method to approximate y, when $x = 0.1$ and $x = 0.2$, given that $x = 0$ when $y = 1$ and $\frac{dy}{dx} = (x + y)$. (15)
8. a) Solve the following equations by the factorization method. (12)
- $$\begin{aligned} 2x + 3y + z &= 9 \\ x + 2y + 3z &= 6 \\ 3x + y + 2z &= 8 \end{aligned}$$
- b) Solve the following equations by Gauss-Seidal iteration method. (12)
- $$\begin{aligned} 27x + 6y - z &= 85 \\ 6x + 15y + 2z &= 72 \\ x + y + 54z &= 110 \end{aligned}$$
- c) Find the inverse of $A = \begin{bmatrix} 1 & 3 & 3 \\ 1 & 4 & 3 \\ 1 & 3 & 4 \end{bmatrix}$ by Gauss elimination method. (11)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 2nd Term Examination, 2017
Department of Computer Science and Engineering
HUM 2207
Economics and Accounting

TIME: 3 hours

FULL MARKS: 210

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

SECTION A

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

1. a) Explain the concept of Economics, Microeconomics and Macroeconomics. (10)
b) What are the fundamental problems of an economy? How these problems are solved in different economics? (10)
c) What is demand curve? Draw a demand curve from the demand function: $D = \frac{16}{P}$. (15)
2. a) What are the properties of a perfect competition market? Explain short run equilibrium of a firm under perfect competition. (17)
b) What is demand elasticity? Find out elasticity at a point of a demand curve. (13)
c) What do you mean by fixed cost and variable cost? (05)
3. a) Prove that $APC > MPC$ in short run but $APC = MPC$ in long run. (20)
b) Show addition of MPC and MPS is one. (10)
c) Distinguish between GNP and NNP. (05)
4. a) Distinguish between autonomous and Induced Investment. (10)
b) Define double counting problem of National Income accounting. (10)
c) Discuss the causes of Inflation. (15)

SECTION B

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

5. a) Define accounting. Discuss the functions of accounting. (10)
b) How can you use your accounting knowledge as a Computer Science engineer? (10)
c) State the rules for determining debit and credit. (10)
d) Define accounting equation. Describe the elements of accounting equation. (05)
6. a) Mr. Pulak decides to open a computer programming service which names Desire IT on January 1, 2014. During the first month of operations, the following transactions occurred:
2014
January-01 Pulak invests Tk. 1,00,000 cash and equipment Tk. 50,000 in the business.
" 02 Purchases computer equipment for Tk. 20,000 cash.
" 03 Purchased supplies from paper supplies company on account Tk. 16,000.
" 05 Received Tk. 12,000 cash from customers for programming services it has provided.
" 06 Received a bill for Tk. 2,500 from the "Daily News" for advertising on account.
" 10 Provides Tk. 35,000 of programming services for customers: cash of Tk. 15,000 is received from customers and the balance of Tk. 20,000 is billed on account.
" 15 Expenses paid in cash for September are store rent Tk. 6,000, salaries Tk. 9,000 and utilities Tk. 2,000.
" 17 Pays Tk. 2,500 "Daily News" advertising bill in cash.
" 20 The sum of Tk. 6,000 in cash is received from customers who have previously been billed for services in transaction 10.
" 25 Paid Tk. 10,000 in cash from the business for salary expense.

Instructions: Prepare a tabular summary of the transactions with column headings: Cash + Accounts Receivable + Supplies + Equipment = Accounts Payable + Mr. Pulak, Capital.

- b) What is accounting cycle? Describe the steps of accounting cycle. (10)

- 7/ a) What is ledger? Why ledger is called the king of all books? (10)
 b) Mr. Rony is a C. A. During the first month of operations of the business, the following events (25)
 and transactions occurred:

2016

- April - 01 Rony invested Tk. 1,00,000 cash.
 " 08 Incurred advertising expenses of Tk. 5,000 on account.
 " 10 Hired secretary at a salary of Tk. 4,000 per month.
 " 12 Paid Tk. 3,600 cash for one year insurance policy.
 " 21 Completed a Tax assignment and billed client Tk.15,000 for services rendered.
 " 22 Received cash of Tk. 20,000 for service completed.
 " 24 Paid Tk. 5,000 on account for advertising incurred.
 " 26 Received Tk. 7,000 advance on a management consulting engagement.
 " 30 Paid secretary Tk. 4,000 for the month as salary.

Instruction: Post the transactions into ledger.

- 8/ The following information are taken from the books of Junaed Enterprise. At the end of the year (35)
 2016, Trial Balance before adjustment shows the following:

Junaed Enterprise
 Trial Balance, December 31, 2016

Account Titles	Debit (Tk)	Credit (Tk)
Cash	6,000	
Accounts Receivable	30,000	
Insurance Expense	9,000	
Inventory 1-1-16	20,000	
Equipment	55,000	
Investment	15,000	
Purchases	75,000	
Sales		90,000
Service Revenue		35,000
Junaed, Capital		97,500
Junaed, Drawing	15,000	
Notes Payable		23,500
Supplies Expense	4,500	
Salaries Expense	15,000	
Utilities Expense	1,500	
Total Tk.	2,46,000	2,46,000

Adjustment data:

- i) Ending inventories valued at Tk. 12,000.
- ii) Supplies consumed during the year 3,000.
- iii) Salaries are payable @ Tk. 2,500 per month.
- iv) Insurance premium has been unexpired Tk. 4,500.

Instructions:

- i) Prepare a statement of comprehensive income for the year ended 31st December, 2016.
- ii) Prepare owner's Equity statement.
- iii) Prepare statement of Financial Position as on 31st December, 2016.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 2nd Term Examination, 2017
Department of Computer Science and Engineering
MATH 2207

Complex Variable, Vector Analysis and Statistics

TIME: 3 hours

FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.

ii) Figures in the right margin indicate full marks.

iii) Necessary tables: t-table, z-table, χ^2 -table.

SECTION A

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

1. a) Evaluate (10)

(i) $\lim_{z \rightarrow 1+i} (z^2 - 5z + 10)$

(ii) $\lim_{z \rightarrow 0} \frac{z}{\bar{z}}$

b) Show that $f(z) = (x^3 - 3xy^2) + i(y^3 - 3x^2y)$, $z \neq 0$; $z = 0$ is continuous and C-R equations (15)
are satisfied but not differentiable at $z = 0$.

c) Determine whether the function $3x^2y + 2x^2 - y^3 - 2y^2$ is harmonic or not. If the function is (10)
harmonic, find the conjugate harmonic function γ and express $u + iv$ as an analytic function
of z .

2. a) Define with an example: (i) Singular point, (ii) Poles, (iii) Branch points, (iv) Removable (15)
singularity, and (v) Essential singularity.

b) Evaluate $\oint_C \frac{e^{3z}}{z - \pi i} dz$, where C is the curve $|z - 2| + |z + 2| = 6$. (08)

c) Evaluate $\oint_C \frac{e^{iz}}{z^3} dz$ where C is the circle $|z| = 2$. (12)

3. a) Define dependence of vectors. Determine whether the vectors are linearly independent or (11)
linearly dependent:

$$\underline{A} = 2\hat{i} + \hat{j} - 3\hat{k}, \quad \underline{B} = \hat{i} - 4\hat{k}, \quad \underline{C} = 4\hat{i} + 3\hat{j} - \hat{k}.$$

b) Find equations for the tangent plane and normal line to the surface $z - x^2 - y^2 = 0$ at the point (12)
(2, -1, 5).

c) Find the most general differentiable function $f(r)$ so that $\underline{r}f(r)$ is solenoidal. (12)

4. a) Evaluate $\int_C \underline{F} \cdot d\underline{r}$, where C is the curve in the xy plane, $y = x^3$ from the point (1, 1) to (2, 8), (10)

if $\underline{F} = (5xy - 6x^2)\hat{i} + (2y - 4x)\hat{j}$.

b) Verify the divergence theorem for $\underline{A} = 2x^2y\hat{i} - y^2\hat{j} + 4xz^2\hat{k}$ taken over the region in the first (18)
octant bounded by $y^2 + z^2 = 9$ and $x = 2$.

c) Define pure rotation and rotation plus translation. (07)

SECTION B

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

5. a) Find the first four moments of the following observations measured from origin. Then find (20)
their corresponding central moments. Also find mean, variance and coefficient of skewness.
Moreover, find Bar diagram of the given frequency distribution.

Class interval	5-7	8-10	11-13	14-16
Observation	2	5	10	3

- b) Fit the following observation in Binomial distribution. Assume that maximum car passing through the road is 4 per minute. (15)

No. of car/min	0	1	2	3	4	>4
Frequency	10	15	20	12	5	0

Test the goodness of fit with 5% level of significance.

6. a) Test whether the following functions are probability distribution function or not. (22)

(i)

x	-1	0	1	2
$P(x)$	$-3k$	$2k$	$4k$	0.5

(ii)

x	-2	0	2	4
$P(x)$	$2k$	$2k$	k	0.5

(iii)
$$P(x) = \begin{cases} kx & \text{if } -1 \leq x \leq 2 \\ 0 & \text{otherwise} \end{cases}$$

Hence if possible find $E(2x+3)$ and $P(-2 \leq x < 2)$ for each instance.

- b) Define a probability density function of Normal distribution whose average is 60 and variance is 4. Then prove that this (the Normal distribution you defined) is a continuous probability distribution. Hence, write its Median, Mode and coefficient of skewness. (13)

7. a) What are the necessary assumptions you need regarding Binomial distribution? In a small town there are 500 families. Each family consists of four children (boys/girls) and their parents. For a single family find the probability that there is (10)

(i) No any boy.

(ii) At least one boy.

In that town how many families you expect that there is no any girl child. (Assume necessary data).

- b) Suppose there are 12000 students in any admission test. Let the average score is 60 (in percentage) and variance is 25. Assume that scores are normally distributed. Find the expected number of students who are (12)

(i) not qualified (i.e. score is less than 40)

(ii) qualified but not eligible for choosing all departments (i.e. $40 \leq \text{score} \leq 80$)

(iii) eligible for choosing any department (i.e. score > 80).

- c) What is the physical meaning of Grad ϕ and $\text{div } \vec{F}$, where ϕ is a scalar quantity and \vec{F} is a vector quantity? Also classify the vector field according to the vector differential operator ∇ . (13)

8. a) Evaluate $\nabla \left(\frac{1}{r} \right)$, $\nabla \cdot \left(\frac{\vec{r}}{r} \right)$ and $\nabla^2 \frac{Mmg}{r^2}$, where \vec{r} is a position vector, M, m are masses and g is gravitational constant. (12)

- b) Find the constants $a, b,$ and c so that the directional derivative of $f = axy^2 + byz + cz^2x^3$ at $(1, 2, -1)$ has a maximum magnitude of 64 in a direction parallel to the normal of the surface $\phi = 10z^3 + 10$ at that point. (11)

- c) Test whether the gravitational force field $\frac{\vec{r}}{r^2}$ is conservative or not. Hence, if possible find the scalar potential of the force field so that the value of the scalar potential at origin is zero. (12)