in collaboration with

Softwarica College of IT & E-commerce | Coventry University

Mathematics for Computer Science

(ST4068CEM)

Assignment Title

Coursework

Intake

SEPTEMBER 2022

Important notes

- Please refer to the Assignment Presentation Requirements for advice on how to set out your assignment. These can be found on the *Softwarica's Moodle Course Page*.
- You are expected to use the CU Harvard referencing format on any written work. For support and advice on how this students can contact Centre for Academic Writing (CAW).
- Please notify your registry course support team and module leader for disability support.
- Any student requiring an extension should follow the university process as outlined at here
- The College cannot take responsibility for any coursework lost or corrupted on disks, laptops or personal computer. Students should therefore regularly back-up any work and are advised to save it on external media or system.
- If there are technical or performance issues that prevent students submitting Coursework through the online coursework submission system on the day of a coursework deadline, an appropriate extension to the coursework submission deadline will be agreed. This extension will normally be 24 hours or the next working day if the deadline falls on a Friday or over the weekend period. This will be communicated via email and as a Softwarica's Moodle announcement.
- You **must** complete the **'Assessment Submission and Declaration Form'**. The form is available on *Softwarica's Moodle Course Page*.
- Please make a note of their commended word count. You could lose marks if you write 10%more or less than this.
- You must submit a paper copy and digital copy (on disk or similarly acceptable medium).Media containing viruses, or media that cannot be run directly, will result in a fail grade being awarded for this assessment.

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Assessment Submission and Declaration Form

PLEASE COMPLETE SECTIONS IN BLOCK CAPITALS

Group work If group work ALL student names and IDs must be added below- on behalf of all members; Name.. ID..................... Name.. ID..................... Name.. ID..................... Name.. ID..................... Name.. ID.....................	**Surname:** LAMSAL **First Name:** BIPASHA **Word Count:**
Student number (ID): 13702568	**Attempt:** FIRST ■ RESIT ☐
Assignment Due Date: 19TH FEB	**Module Code:** ST4068CEM

Programme Title: BSC HONS COMPUTING
Module Title: MATHEMATICS FOR COMPUTER SCIENCE

Name of Supervisor or Tutor (if applicable): SHANTA RAYAMAJHI	**Individual Work:** ■	**Group Work:** ☐
Assessment Title and Type(ie essay, journal, CD, Dissertation)	COURSEWORK	WRITTEN

I have read the Softwarica College rules and regulations on the submission of academic work and in particular the sections concerning misconduct in assessment, including plagiarism, collusion and cheating. I certify that this assignment is the result of my ownS (or group) work and contains no unreferenced material from another source and does not contravene any part of the College's rules and regulations.

I acknowledge that in submitting this work I am declaring that I (or my group) are fit to be assessed and that a deferral may not be requested following hand in.

I confirm that an electronic version of the item to be assessed where appropriate) is available and will be made available to the College by the specified deadline via Moodle.

In respect of group assignments, the submission of this work is made on the basis that all group members are jointly and severally responsible for the work presented for assessment and that by handing in this item for

Section: A **[60 Marks]**

There are (FOUR) 4 questions in this section, attempt ALL questions.

Q.N.1

a.

i. Find the truth value of $\neg (p \wedge q) \Rightarrow r$ if p and r are false, and q is true.

(2 marks)

ii. What is the truth value if the brackets are removed?

(2 marks)

b.

Let p and q be the proposition

p: Swimming is allowed.

q: Sharks have been spotted near the shores

Express each of the following compound propositions as an English sentence.

(6 marks)

i. $p \wedge q$:

ii. $\neg p \vee q$:

iii. $p \rightarrow \neg q$:

c. Write converse, inverse and contrapositive of "If today is my birthday, then I will get cake." (3 marks)

Q.N.2

a. We consider the problem of controlling a nuclear reactor. Given the atomic sentences "The operator presses the alarm", "the reactor is in danger of melting down", "The control process closes down the reactor", and "The core temperature is rising rapidly", represent the first by A, the second by B, the third by C and the last by D. Convert into English

i. $B \Rightarrow (A \vee C)$

ii. $A \vee \neg D$

iii. $(A \wedge B) \Rightarrow C$

iv. $(A \vee D) \Rightarrow (C \Leftrightarrow B)$

(8 marks)

b. Convert into symbolic form

i. If the operator presses the alarm and the core temperature is not rising rapidly then the control process does not close down the reactor.

ii. If the core temperature is rising rapidly then the reactor is in danger of melting down and the operator presses the alarm.

iii. If the core temperature is rising rapidly then the reactor is in danger of melting down or the operator presses the alarm.

(6 marks)

Q.N.3

a. Construct a truth table to establish the following compound propositions tautology, contradiction or contingency: $[(p \wedge q) \vee [\sim p \vee (p \wedge \sim q)]$

(5maks)

b. Prove the following statements are tautology

a. $[(p \wedge \neg q) \vee \neg p] \vee q$ (4 marks)

ii. $[p \vee (\neg p \wedge q)] \vee (\neg p \wedge \neg q)$ (4 marks)

Q.N. 4

a. Prove by the method of Mathematical Induction:

$1.2 + 2.3 + 3.4 \dots\dots + n(n+1) = \frac{n(n+1)(n+2)}{3}$

(5 marks)

b. Using the principle of mathematical induction, prove that $(n^2 + n)$ is even for all $n \in N$.

(7 marks)

c.

i. Give a Recursive formula for: 6, 12, 18, 24, 30……

(4 marks)

ii. Given a recursive sequence if $t_{n+1} = t_n + t_{n-1}$ Where

$t_0 = 1$ and $t_1 = 3$ then find t_5 (4 marks)

Section: B [40 Marks]

There are (THREE) 3 questions in this section, attempt ALL questions.

Q.N.1

a. State which rule of inference is used in the argument:

If it rains today, then we will not have a barbecue today. If we don't have a barbecue today, then we will have a barbecue tomorrow. Therefore, if it rains today, then we will have a barbecue tomorrow.

(5 marks)

b. Translate the following argument into propositional calculus and test for validity using truth table. "If Fred has access to file file.dat then it is encrypted. If file.dat is not encrypted, then it cannot be in a publically accessible directory. Therefore, Fred has access to file.dat and it is not in a publically accessible directory."

(5 marks)

c. Show that the hypothesis is valid: It is not sunny this afternoon and it is colder than yesterday. We will go swimming only if it is sunny. If we don't go swimming, then will take a canoe trip, if we take a canoe trip, then we will be home by sunset. Therefore, we will be home by sunset.

(6 marks)

Q.N.2

Let, Predicates:

J(x): x is judges

S(x): x is sober

D(x): x is defendants

H(x): x is honest.

L(x): x is lawyers.

I(x): x is innocents

P(x): x is plaintiffs

a. Express the following using the language of predicate calculus, where it is understood that the people being discussed is in the courtroom.

i. All judges are sober. (2 marks)

ii. All defendants are innocents. (2 marks)

iii. Some plaintiffs are lawyers (2 marks)

b. Express the following in normal English:

i. $\forall x \in C: J(x) \vee S(x)$ (2 marks)

ii. $\forall x \in C: H(x) \wedge L(x) \Rightarrow S(x)$ (2 marks)

c. Give the negation of each statement both in symbolic form and in natural English.

i. All judges are sober. (2 marks)

ii. There is a dishonest lawyer (2 mark)

Q.N.3

c. Construct the formal Proof to show that

i. $A, A \Rightarrow B, C \Rightarrow \neg B \vdash \neg C$ (5 marks)

ii. $P \vee Q, Q \Rightarrow \neg R, R \vdash P$ (5 marks)

The End

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Answer Sheet

Name: Bipasha Lamsal

(1)

(a)

(i) Sol'n,

$\neg(p \wedge q) \rightarrow r$

$\neg(F \wedge T) \rightarrow F$

$= \neg F \rightarrow F$

$= T \rightarrow F$

$= F$

If the brackets are removed,

$\neg F \wedge T \rightarrow F$

$= T \wedge T \rightarrow F$

$= T \rightarrow F$

$= F$

(b) (i) $p \wedge q$:

→ Swimming is allowed and sharks have been spotted near the shores.

(ii) $\sim p \vee q$:

→ Swimming is not allowed or sharks have been spotted near the shores.

(iii) $p \rightarrow \sim q$:

→ If swimming is allowed then sharks have not been spotted near the shores.

(c) $\sim q \rightarrow p$ (converse)

→ "If I get cake today, then today is my birthday."

Inverse : $\sim p \rightarrow \sim q$

→ If today is not my birthday, then I will not get cake.

Contra-positive ($\sim q \rightarrow \sim p$)

→ If I don't get cake, then it's not my birthday today.

(2)

(a) Convert into English.

A : The operator presses the alarm.

B : The reactor is in danger of melting down

C : The control process closes down the reactor.

D : The core temperature is rising rapidly.

$B \to (A \vee C)$

(1 = If the reactor is in danger of melting, then the operator presses the alarm or the control process closes the reactor.

$A \vee \sim D$

= The operator presses the alarm or the core temperature is not rising rapidly.

$(A \wedge B) \to C$

= If the operator presses the alarm and the reactor is in danger of melting down then the control process closes down the reactor.

$(\cdot A \vee D) \to (C \Leftrightarrow B)$

= If the operator presses the alarm or core temperature is rising rapidly, then the control process closes down the reactor if and only if the reactor is in danger of melting down.

(1

(b) $\to$ $(A \wedge \sim D)$

(i) $\to$ $\cancel{(A \wedge D)} \to \sim C$

(ii) $D \to B \wedge A$

(iii) $D \to B \vee A$

(3)

(a) Truth Table:

$$[(p \wedge q) \vee (\sim p \vee (p \wedge \sim q))]$$

p	q	~p	~q	p∧q	p∧~q	~p∨B	A∨C
T	T	F	F	T	F	F	T
T	F	F	T	F	T	T	T
F	T	T	F	F	F	T	T
F	F	T	T	F	F	T	T

∴ It is tautology [All Truth]

(6)

(i) $[(p\wedge\sim q)\vee\sim p]\vee q \equiv T$

$= [\sim p\vee(p\wedge\sim q)]\vee q$ (commutative law)

$= [(\sim p\vee p)\wedge(\sim p\vee\sim q)]\vee q$ (distributive law)

$= [T\wedge(\sim p\vee\sim q)]\vee q$ (Negation law)

$= (\sim p\vee\sim q)\vee q$ (identity law)

$= \sim p\vee(\sim q\vee q)$ (associative law)

$= (\sim q\vee q)\vee\sim p$ (commutative law)

$= T\vee\sim p$ (Negation law)

$= T$ (Domination law)

(ii) $[p\vee(\sim p\wedge q)]\vee(\sim p\wedge\sim q)$

$= [(p\vee\sim p)\wedge(p\vee q)]\vee(\sim p\wedge\sim q)$ [Distributive Law]

$= [T\wedge(p\vee q)]\vee(\sim p\wedge\sim q)$ [Negation law]

$= (p\vee q)\vee(\sim p\wedge\sim q)$ [Identity law]

$= (p\vee q)\vee(\sim p\vee q)$ [Demorgan's law]

$= T$ #

(4)

(a) $1\cdot 2+2\cdot 3+3\cdot 4+\cdots+n(n+1) = \frac{n(n+1)(n+2)}{3}$

Let the given statement be $p(n)$

$p(n): 1\cdot 2+2\cdot 3+3\cdot 4+\cdots+n(n+1)$

Basic step:

Let $n=1$,

$1\times 2 = \frac{1(1+1)(1+3)}{3}$

$2=2$ (True)

Inductive step:

Let us suppose n=k is true.

$1\cdot 2 + 2\cdot 3 + 3\cdot 4 + \dots + k(k+1) = \frac{k(k+1)(k+2)}{3}$ ... (i)

Now,

Adding (k+1) to the both sides of eq-(i)

$1\cdot 2 + 2\cdot 3 + 3\cdot 4 + \dots + k(k+1) + k+1[(k+1)+1] = \frac{k+1(k+2)(k+3)}{3}$

LHS,

$\frac{k(k+1)(k+2)}{3} + (k+1)(k+2)$

$= \frac{k(k+1)(k+2) + 3(k+1)(k+2)}{3}$

$= \frac{(k+1)(k+2)(k+3)}{3}$ RHS proved

where n=k+1, which is true for $n \in N$.

(b) (n^2+n) is even for all $n \in N$.

Basic step:

when n=1,

$1^2+1=2$ which is even, (True)

Now,

Considering, n=k is true. k^2+k is even

$k^2+k = 2m, m \in N$

Then, $(k+1)^2 + (k+1)$

$= k^2+2k+1+k+1$

$= (k^2+k)+2k+2$

$= 2\cdot m + 2(k+1)$: $2m+2k+1$

$= 2(m+k+1)$ which is even number.

~~where, n=k+1, is true~~ o

So, n=k+1 is true & hence n=k.

$\therefore \forall n \in N$ ~~p(n)~~ is true.

(c)

(i) Recursive formula for:

$6, 12, 18, 24, 30 \ldots$

$t_1 = 6$

$t_2 = t_1 + 6$

$t_3 = t_2 + 6$

$t_4 = t_3 + 6$

$t_5 = t_4 + 6$

So,

$t_n = (t_{n-1}) + 6$ #

(ii) Soln,

$t_{n+1} = t_n + t_{n-1} \ldots (i)$

where,

$t_0 = 1$ and $t_1 = 3$

$t_5 = ?$

Now,

When n = 1,

In Eqn (i),

$t_{1+1} = t_1 + t_{1-1}$

or, $t_2 = t_1 + t_0$

$= 3 + 1$

$\therefore t_2 = 4$

When n = 2 in eqn (i)

$t_{2+1} = t_2 + t_{2-1}$

$= t_2 + t_1$

$= 4 + 3 = 7$

When n = 3 in eqn (i)

$t_{3+1} = t_3 + t_{3-1}$

$= 7 + 4 = 11$

$\therefore t_4 = 11$

Then,

When $n = 4$ in eqn (i)

$t_{4+1} = t_4 + t_{4-1}$

$t_5 = t_4 + t_3$

$t_5 = 11 + 7$

$\boxed{\therefore t_5 = 18}$ #

$\therefore t_5 = \underline{18}$

Section - B

(1)

(a) Sol^n,

p: It rains today

q: we will have a barbeque today.

r: we will have barbeque tomorrow.

(1) $p \rightarrow \sim q$

(2) $\sim q \rightarrow r$

Conclusion, $p \rightarrow r$

Assertion	Justification
(1) $p \rightarrow \sim q$	Hypothesis
(2) $\sim q \rightarrow r$	Hypothesis
(3) $p \rightarrow r$	Hypothetical syllogism on 1 & 2.

(b) → Sol^n,

p: Fred has access to file.dat.

q: It is encrypted.

r: It can be in publically accessible directory.

Conclusion: Fred has access to file.dat and it is not in publically accessible directory.

Hypothesis:

(i) $p \to q$

(ii) $\sim q \to \sim r$

Conclusion: $p \wedge \sim r$

p	q	r	$\sim q$	$\sim r$	$p \to q$	$\sim q \to \sim r$	$p \wedge \sim r$
T	T	T	F	F	T	T	F ✗
T	T	F	F	T	T	T	T ✓
T	F	T	T	F	F	F	F
T	F	F	T	T	F	T	T
F	T	T	F	F	T	T	F ✗
F	T	F	F	T	T	T	F ✗
F	F	T	T	F	T	F	F
F	F	F	T	T	T	T	F

∴ Given argument is invalid.

(c) → Sol^n,

p: It is sunny this afternoon.

q: It is colder than yesterday.

r: we will go swimming.

s: we will take a canoe trip.

t: we will be home by sunset.

Hypothesis;

(1) $\sim p \wedge q$

(2) $r \to p$

(3) $\sim r \to s$

(4) $s \to t$

Conclusion,

∴ t

Assertion	Justification
(1) $\sim p \wedge q$	Hypothesis
(2) $r \to p$	Hypothesis
(3) $\sim r \to s$	Hypothesis
(4) $s \to t$	Hypothesis
(5) $\sim p$	simplification on 1
(6) q	simplification on 1
(7) $\sim r \to t$	Hypothetical syllogism
(8) $\sim r$	using Modus Tollens on 2 & 5
(9) t = conclusion	Using Modus ponens on 7 & 8

(2)

9

i) $\to \forall x \, [J(x) \to S(x)]$

ii) $\to \forall x \, [D(x) \to I(x)]$

iii) $\exists x \, [P(x) \wedge L(x)]$

b) i) $\to$ All the people from courtroom are either judges or sober.

ii) $\to$ All honest lawyers are sober.

c) i) $\to$ Some judges are not sober.

$\exists x \, [J(x) \vee S(x)]$

ii) $\to$ All honest people are not lawyer.

$\forall x \, [h(x) \to \sim L(x)]$

(3)

(c) (i) $A, A \to B, C \to \sim B \vdash \sim C$

Assertion	Justification
(1) A	Hypothesis
(2) $A \to B$	Hypothesis
(3) $C \to \sim B$	Hypothesis
(4) B	using Modus Ponens in (i) & (ii)
(5) $\sim C$	using Modus Tollens in (iii) & (iv)

(ii) $P \vee Q, Q \to \sim R, R \vdash P$

Assertion	Justification
(i) $P \vee Q$	Hypothesis
(ii) $Q \to \sim R$	Hypothesis
(iii) R	Hypothesis
(iv) $\sim Q$	Using Modus Tollens in (ii) & (iii)
(v) P	Using Disjunctive syllogism on (i) & (iv).