UNITED INTERNATIONAL UNIVERSITY
Department of Computer Science and Engineering (CSE)

Course Title: Theory of Computation	**Course Code: CSE 2233**	**Credit Hours: 3.0**
Trimester & Year: Fall 2021	**Section: A**	**AZ**

CT-03

Total Marks: 20 Time: **45** min

1. Find a CFG that generates the following languages. **3**

(a) $L(G) = \{ a^n b^m \mid 0 \le n \le m \le 2n \}$

2. Which language generates the grammar G given by the productions: **3**

$$S \rightarrow aSa \mid aBa$$
$$B \rightarrow bB \mid b$$

3. Given the following ambiguous context free grammar: **2+2+2**

$$S \rightarrow Ab \mid aaB$$
$$A \rightarrow a \mid Aa$$
$$B \rightarrow b$$

a. Find the string s generated by the grammar that has two rightmost derivations and show the derivations.
b. Show the bottom Up parse trees for the derivations
c. Find the equivalent unambiguous CFG

4. Explain why the grammar below is ambiguous **3**

$$S \rightarrow 0A \mid 1B$$
$$A \rightarrow 0AA \mid 1S \mid 1$$
$$B \rightarrow 1BB \mid 0S \mid 0$$

5. Convert the following CFG into an equivalent CFG in Chomsky Normal Form **5**

S → aXbX

X→ aY | bY | €

Y → X | c