COVID – 19 (ONLINE EXAMINATION)

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देव संस्कृति विश्वविद्यालय

शान्तिकुन्ज, हरिद्वार

आन्तरिक मूल्यांकन परीक्षा – INTERNAL EVALUATION TEST

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1		
कुल योग अंकों में / TOTAL IN DIGITS		
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Aniket

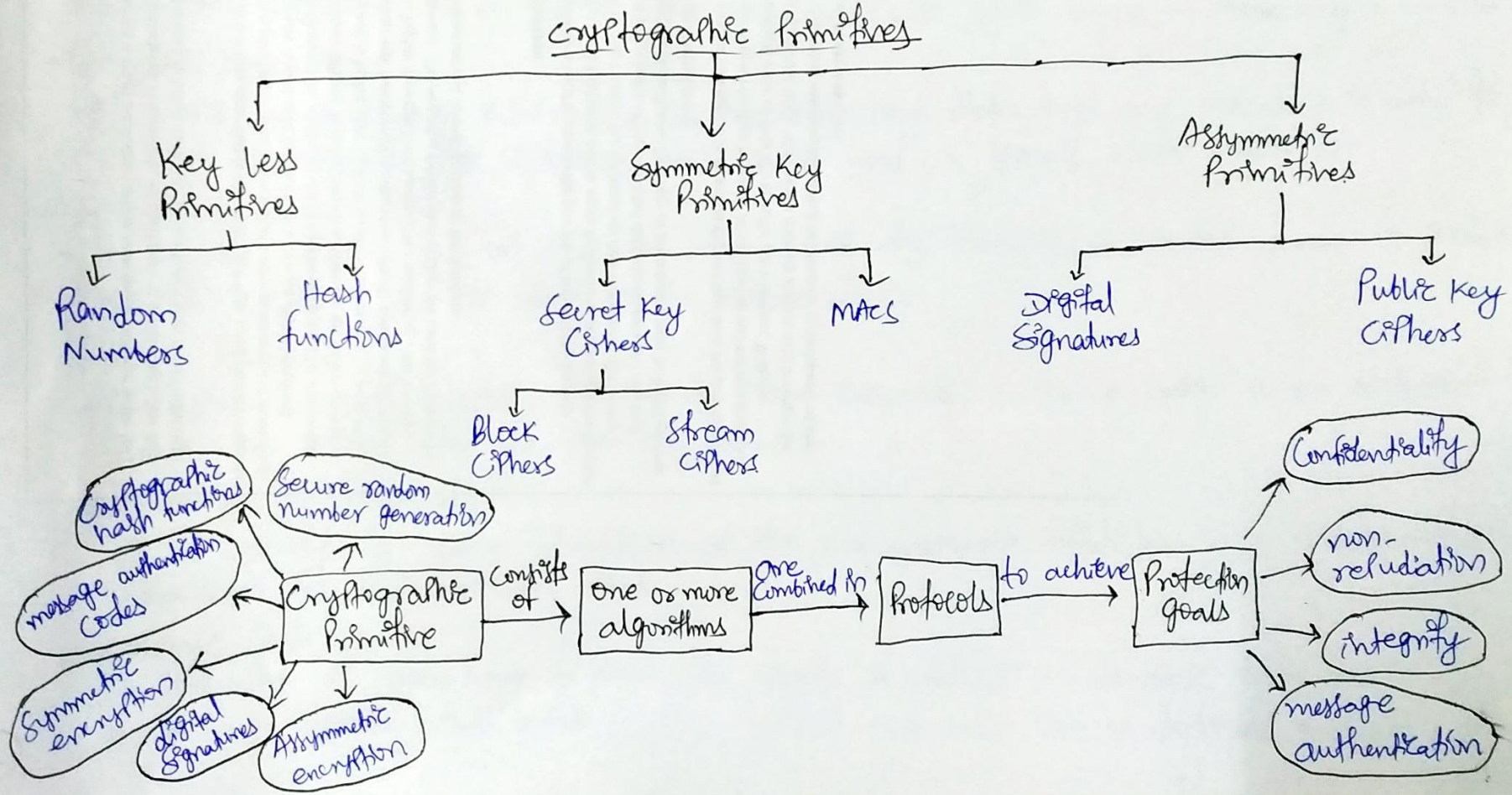
परीक्षार्थी के हस्ताक्षर
Signature of student's

परीक्षक के हस्ताक्षर
Signature of Examiner

Short Answer

Ans 1 Cryptographic Primitives are well-established, low-level cryptographic algorithms that are frequently used to build cryptographic protocols for Computer Security Systems.

- In Simpler terms, we can say that Cryptographic Primitives are basic building-blocks of a Security Protocol or Systems.



Ans 2 Applications of Cryptography

- Authentication/Digital Signatures
  - It is used when someone wants to verify the origin of a document, the identity of the sender, the time and date, of a document was sent and/or signed, and so on.
  - A digital signature is a cryptographic means through which many of these may be verified.
- Encryption/Decryption
  - It works by employing Public Key Cryptography and these keys are required in order to encrypt or decrypt the ciphertext and can be used in email, social media, etc.
- SIM Card Authentication
  - To decide whether or not the SIM may access the network, a random number is generated by the operator, and is sent to the mobile device.
- Storing Passwords
  - Encryption alongwith hashing is used to store passwords, so that a system or an attacker have no access to the plaintext password.
- Reliability in Transmission
  - It is ensured by using checksum of the communicated information and verifying the checksum at the recievers end.
- Electronic Cash
  - Cryptography is used here to keep the assets of nations in electronic form securely.
  - If such systems would be forged, the national economies can be destroyed instantly.

Long Answer

Ans 1

Classical Cipher
- Shift Cipher
- Mono-alphabetic Substitute Cipher
- Poly-alphabetic Substitution (Vigenere Cipher)

(I) Shift Cipher

Encryption - Shift each Plain-text character by 'K' Positions "forward" or vice-versa.

Decryption - Shift each Cipher-text character by 'K' Positions "backward" or vice-versa.

Cryptoanalysis of Shift Cipher
- Plaintext : $m = (m_1, \ldots, m_e)$
- Ciphertext : $c_i = (c_1, --, c_d)$

Attack model : Ciphertext only Attack (COA)

- It is Symmetric cryptosystem as it uses a shared secret.

Information Known to attacker
- Ciphertext
- Process through which the ciphertext is generated, i.e., $C_i = (M_i + \text{Shift}) \bmod 26$

Attack
- Brute force attacks are usually simplest to implement here as there are only 26 Candidate keys.

Frequency Analysis

- As English alphabets have only 26 letters, it is easy to use brute force attack here, but if we use some other alphabet, which has hundreds of characters, it ~~wasn't easy~~ wouldn't be easy to use brute force.
- we compare the frequency of characters by, $\sum_{i=A}^{i=Z} \frac{(C_i - E_i)^2}{E_i}$

Here, C_i = no. of times the ith letter occurred in the ciphertext.

E_i = the expected no. of times the ith letter should occur in a string.

② Mono alphabetic Substitute Cipher

- It fixes the cipher alphabet for a given key.
- This means that every instance of a Plaintext character will encode to the same Ciphertext letter, regardless of the character's position in the Plaintext.
- frequencies are swapped or flattened for more complex substitutions.

Cryptoanalysis

Encryption - Map each Plaintext character to an arbitrary ciphertext character in a one-to-one fashion.

Key - A secret permutation (determined by the key generation algorithm).

Attack - Here, Brute force attack is impractical, as no. of Candidate keys = $26! \approx 2^{88}$.

frequency analysis - Applicable when Plaintext space is a natural language.

Idea - Exploit the redundancy present in the underlying natural language.

③ Polyalphabetic Substitution cipher.

- It uses different alphabets in the encryption process to further diffuse letter frequencies and make decryption harder.
- Provides one-to-many or many-to-many relationship between letters.

Cryptoanalysis

Two stage approach

- Stage 1 - determine the length t of the unknown key.
  - Uses Kasiski's method, Index of Coincidence method.
- Stage 2 - Try to determine the characters $K_1, K_2, \ldots K_t$.

Examples

① Shift cipher

Plain text - ANIKET

Key - 3

Cipher text - DQLNHW

② Mono alphabetic Substitute Cipher

Plain text - ANIKET

Key - WXLSTJPRBCIZKGQDOFEHVNUMAY

Ciphertext - WGBITH

Here, each letter of alphabet is mapped to another letter, hence difficult to implement brute force attack here.

③ Polyalphabetic Substitution Cipher

Plaintext - ANSKET	ANIKET
Key - hge	hgehge
Ciphertext - the rxp	therxp

The best feature of this cipher is that same plaintext character is substituted by different ciphertext characters.

Thus, there were the cryptoanalysis on ~~the~~ some classical ciphers.