msc – CS – NEP2020 – sem I

Time: 02 Hours [Total Marks: 50]

N.B: (1) All questions are compulsory.
(2) Figures to the **right** indicate full marks.
(3) **Assume additional data if necessary** but state the same clearly.
(4) Symbols have their usual meanings and tables have their usual standard design unless stated otherwise.
(5) **Draw suitable illustrations** wherever necessary.

Q.1 Attempt **any two** of the following **(10)**

a) Explain the concept of periodic signals. Provide examples of periodic signals and discuss their significance in digital signal processing. **05**

b) What is the difference between white noise, Brownian noise, pink noise, and Gaussian noise? What effect does noise have on signal and image processing? **05**

c) Define autocorrelation and explain its significance in signal and image processing **05**

d) Discuss the process of representing an image as a signal. How does sampling and the Fourier Transform contribute to this representation? **05**

Q.2 Attempt **any two** of the following **(10)**

a) Define image processing and discuss its various applications in real-world scenarios. How does image processing enhance the quality and usability of images? **05**

b) Discuss intensity transformations in image processing. Explain the concepts of log transform, power-law transform, and contrast stretching with suitable examples. **05**

c) Describe the techniques used for linear and non-linear smoothing of images. How do these techniques differ in their approach to reducing noise and preserving image details? **05**

d) Define image derivatives and gradients. Explain the Laplacian operator and its role in edge detection. **05**

Q.3 Attempt **any two** of the following **(10)**

a) Discuss the process of skeletonizing in morphological image processing. How does this technique reduce an image to its essential structure? **05**

b) Discuss the LoG (Laplacian of Gaussian) and DoG (Difference of Gaussian) filters. How are these filters used in edge detection, and what are their respective strengths and weaknesses? **05**

c) What are image pyramids, and why are they used in image processing? Explain the concepts of Gaussian Pyramid and Laplacian Pyramid. **05**

d) Define morphological image processing. Describe the operations of erosion and dilation and their effects on binary images. **05**

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Q.4 Attempt **any two** of the following

a) Describe the Harris Corner Detector. How does it detect corners in an image, and what makes it robust for corner detection?

b) What is the Histogram of Oriented Gradients (HOG) method? Describe its application in feature extraction and object detection.

c) Describe Haar-like features. How are these features used in object detection, particularly in the context of face recognition?

d) Compare and contrast edge-based and region-based segmentation techniques.

Q.5 Attempt **any two** of the following

a) Compare and contrast the techniques of smoothing using lowpass filters and sharpening using high-pass filters. How does the Fast Fourier Transform (FFT) facilitate these operations?

b) What is thresholding in image processing? Describe its importance and provide examples of how thresholding is used to segment images.

c) What is the purpose of opening and closing operations in morphological image processing? Explain with suitable example.

d) Explain the concept of Scale-Invariant Feature Transform (SIFT). How does SIFT achieve scale and rotation invariance in feature detection?

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MSC – CS – NEP 2020 Sem. 1

Time :2 ½ Hours [Total Marks: 50]

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Q.1	Attempt **any two** of the following	(10)
a)	State and Explain the any five differences between LAN and MAN.	05
b)	Write a short note on TCP/IP model.	05
c)	Discuss the Implementation of IPv4 along with their components.	05
d)	Explain reverse encapsulation (de-encapsulation) process.	05
Q.2	Attempt **any two** of the following	(10)
a)	What are different elements of Modern Technology? Explain any One in detail.	05
b)	Discuss Openflow in detail with example.	05
c)	State and Explain any five disadvantages of Software Defined Networking.	05
d)	Explain key elements in unified communication.	05
Q.3	Attempt **any two** of the following	(10)
a)	Write a short note on NFV along with domain component.	05
b)	Explain the advantages of SDN Virtualization.	05
c)	Write a short note on Fog Compting.	05
d)	Write a short note on Virtualization Quality of Services.	05
Q.4	Attempt **any two** of the following	(10)
a)	Write a short note on Route Redistribution.	05
b)	Write a short note on Natting.	05
c)	How does hello message help in OSPF?	05
d)	Explain Policy based routing in detail.	05
Q.5	Attempt **any two** of the following	(10)
a)	Explain any one routing protocol in detail.	05
b)	Write a short note on SDN Data Plane.	05
c)	How Virtualization plays important role in Software Defined Networking?	05
d)	Write a short note on Access control List(ACL).	05

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MSc - Sem I Computer Science (NEP 2020)

(Time :1 Hours) [Total Marks: 25].

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Q.1 Attempt **any two** of the following **(10)**

a) Define regular expression. Generate regular expression for the following statement. **05**
- (0+1) * 0
- (b* (aaa)* b*) *

b) List out drawbacks of top- down parser. Eliminate left recursion from the following production set. **05**

S → P

P → Pd / Pe / aQ / ac

Q → bQc / f

c) Write a note on syntax analyzer generator YACC. **05**

d) Consider the grammar **05**

E –> 2E2
E –> 3E3
E –> 4

Perform Shift Reduce parsing for input string "32423"

Q.2 Attempt **any two** of the following **(10)**

a) What is Loop Optimization in Compiler Design? Perform induction variable elimination for the following three address code. **05**

i:= i+1
x:= 3*i
y:= a[x]
if y< 15, goto B2

b) What is activation record? Explain the activation record. **05**

c) Explain machine dependent and machine independent optimization techniques. **05**

d) Discuss debugging and testing process used in compilation. **05**

Q.3 Attempt **any one** of the following **(05)**

a) State the general form of Postfix and infix notation. convert the following infix expression to postfix form **05**

(A-B)*(C/D)$F
A+B/C$E+F*G

b) Explain the phases of compiler. **05**

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M.Sc (C.S) Nf P 2020

(Time :1 Hours) [Total Marks: 25].

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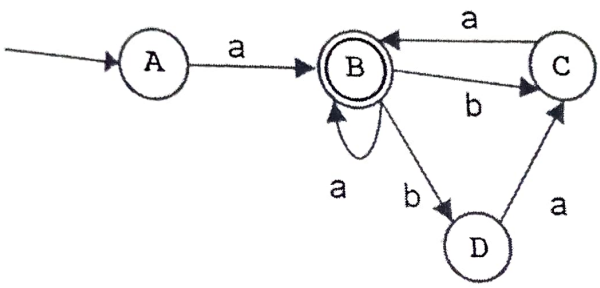
Q.1 Attempt **any two** of the following **(10)**

a) Write algorithm for conversion of NDFA to DFA and convert the following NDFA to DFA **05**



b) Compare between top-down and bottom-up parsing. Consider a simple grammar given it recognizes strings containing number of *a*'s followed by at least one *b* **05**

$S \rightarrow AC$
$A \rightarrow aA \mid \varepsilon$
$C \rightarrow b \mid bC$

Generate the top-down derivation for the string *aaab*.

c) Compute FIRST and FOLLOW for the following production **05**

E->TE
E'->+TE'
E->λ
T->FT'
T-> *FT'
T' -> λ
F-> (E)
F-> id **05**

d) $A \rightarrow C$
$A \rightarrow (A * C)$
$C \rightarrow 0$
1) Is G LL (1) justify?
2) Prepare Predictive Parsing table for G.
3) Parse the string (0 * 0)

Q.2 Attempt **any two** of the following (10)

a) Apply Loop Optimization Technique on the given Three Address Code 05

1) a=10

2) B=1

3) C=7*b

4) D= A-4

5) E= D *5

6) B= B*2

7) if B <=10 go to 3

8) go to 8

b) Translate the following expression into Quadruples, Triples, Three-address code. 05

1) (a+b)*(c+d)+(a+b+c)

2) A+(b*c)/(-b*-c+d)

c) Discuss loop unrolling and loop jamming with suitable example. 05

d) What is DAG? Draw the DAG for the following expression. 05

(a + a * (b - c)) + ((b - c) * d)

Q.3 Attempt **any one** of the following (05)

a) Draw a block diagram of compiler and explain front phases of complier. 05

b) Explain various notations used in regular expression. Draw the following regular expressions. 05

1. (a * b) + a * b * b

2. b * a + a * + a b b b *

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MSc = Sem I CS (NEP 2020)

(Time : 1 Hours) [Total Marks: 25].

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- (0+1) * 0
- (b* (aaa)* b*) *

b) List out drawbacks of top- down parser. Eliminate left recursion from the following production set. **05**

S → P

P → Pd / Pe / aQ / ac

Q → bQc / f

c) Write a note on syntax analyzer generator YACC. **05**

d) Consider the grammar **05**

E –> 2E2
E –> 3E3
E –> 4

Perform Shift Reduce parsing for input string "32423"

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if y< 15, goto B2

b) What is activation record? Explain the activation record. **05**

c) Explain machine dependent and machine independent optimization techniques. **05**

d) Discuss debugging and testing process used in compilation. **05**

Q.3 Attempt **any one** of the following **(05)**

a) State the general form of Postfix and infix notation. convert the following infix expression to postfix form **05**

(A-B)*(C/D)$F
A+B/C$E+F*G

b) Explain the phases of compiler.

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MSC- Computer Science Semister I

Time :2 ½ Hours

[Total Marks: 60]

N.B: (1) **All questions are compulsory.**
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Q.1	Attempt **any two** of the following	(12)
a)	Explain the features of Object Oriented Database.? And Explain the characteristics of RDBMS.	06
b)	Explain the architectural model of distributed DBMS.	06
c)	Explain conceptual Data models for Spatial database.	06
d)	Explain Object Database Management Group (ODMG) object model.	06
Q.2	Attempt **any two** of the following	(12)
a)	Explain types of distributed Database system? Explain the disadvantages of Distributed DBMS?	06
b)	Explain different layers of Transparency DBMS ?	06
c)	Explain horizontal and vertical fragmentation. With the help of diagram.	06
d)	Explain Temporal Database with example.	06
Q.3	Attempt **any two** of the following	(12)
a)	Briefly explain NoSql and its characteristics ?and How Bigdata is related to NoSql?	06
b)	Difference between SQL and NOSQL database. Where to use NoSQL database?	06
c)	Explain Document Database briefly.	06
d)	Explain CAP theorem with diagram.	06
Q.4	Attempt **any two** of the following	(12)
a)	Write short note on Hive.	06
b)	Compare HQL and SQL.	06
c)	Explain different types of NoSQL.	06
d)	What are Cassandra and MongoDB?	06
Q.5	Attempt **any two** of the following	(12)
a)	What is Distributed Transparent System? Explain its types.	06
b)	Explain Architectural model of distributed system.	06
c)	How to deal with Big Data and scalability of NoSQL	06
d)	Explain REDIS and its applications and advantages of REDIS.	06

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Paper / Subject Code: 94744 / Computer Science: Algorithms for Optimization (R-2021-22)

MSC - CS - Sem I

Time : 2 ½ Hours | Total Marks : 60

N.B: (1) **All questions are compulsory.**
(2) Figures to the **right** indicate full marks.
(3) **Assume additional data if necessary** but state the same clearly.
(4) Symbols have their usual meanings and tables have their usual standard design unless stated otherwise.
(5) Use of **calculators** and statistical tables are **allowed**. / If required keep it.

Q.1	Attempt **any two** of the following	(12)
a)	Discuss design optimization process and basic optimization problem.	6
b)	What are local minima? What are different types of local minima?	6
c)	What do you mean by brackets? How we can find initial brackets.	6
d)	Write a note on Fibonacci series.	6
Q.2	Attempt **any two** of the following	(12)
a)	Explain concept of Gradient descent in detail.	6
b)	Discus Adadelt and RMSProp in detail.	6
c)	Give the difference between first order method and second order method.	6
d)	Write a note on Newton's Method and Quasi- Newton Method.	6
Q.3	Attempt **any two** of the following	(12)
a)	Explain the concept of full factorial sampling plan with its algorithm.	6
b)	Write a note on Stratified Sampling.	6
c)	Explain the concept of Surrogate Model. How to fit surrogate model to any true objective function?	6
d)	Write a note on Gaussian process.	6
Q.4	Attempt **any two** of the following	(12)
a)	What is Uncertainty? What are different types of Uncertainty?	6
b)	Explain Bayesian Monte Carlo integration.	6
c)	Explain Ant Colony Optimization algorithm.	6
d)	Define Grammar with example.	6
Q.5	Attempt **any two** of the following	(12)
a)	What do you mean by critical point? What are types to optimize the process?	6
b)	Explain hyper gradient descent.	6
c)	What is sampling plan?	6
d)	How genetic programming implemented with Tree?	6

[Time: 2 and 1/2 Hours] [Total Marks: 60]

Please check whether you have got the right question paper.

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

Q.1 (A) Attempt any **two** of the following:

(a) Derive expressions for the wave function of sp^3 hybrid orbitals using the concept of hybridization. 4

(b) Explain the bonding in SF_6 molecule on the basis of molecular orbital theory. Draw the molecular orbital diagram showing the distribution of electrons in various molecular orbitals. 4

(c) What is resonance energy? Draw all possible resonating structures for nitrate ion. Calculate the formal charges for all the atoms in the ion. 4

(d) What are van der Waals forces? Discuss any two types with suitable examples. 4

(B) Attempt any **one** of the following:

(a) On the basis of Valence Bond Theory, explain the structure and bonding of ClF_3 and PF_5 4

(b) Construct a labelled molecular orbital diagram of Vanadium molecule. Explain the magnetic behaviour of the molecule. 4

Q.2 (A) Attempt any **two** of the following:

(a) Construct character table for H_2O point group 4

(b) On the basis of SALC, draw Molecular Orbital diagram for ammonia molecule. 4

(c) Define subgroups. Give subgroups of $C2v$ point group 4

(d) Derive the matrix representation for rotational operation. 4

(B) Attempt any **one** of the following:

(a) Discuss the criteria for a set of elements to form a group by giving suitable example. 4

(b) Write a short note on irreducible representations. 4

Q.3 (A) Attempt any **two** of the following:

(a) Describe the properties of conductors and semiconductors on the basis of Band theory. 4

(b) Explain Langmuir-Blodgett method of preparation of nanomaterials. 4

(c) Draw the structure of Rutile compound. State the features of the structure. 4

(d) What are the principles underlying ceramic method and precursor method for preparation of inorganic solids? 4

(B) Attempt any **one** of the following:

(a) Comment on concept of First Brillouin zone in solids. 4

(b) Schematically represent formation of bands in solids using Band Theory. 4

(3)

4. B) Attempt ***any one*** of the following:

i) Calculate the mean ionic activity coefficient of $AlCl_3$ in aqueous solution containing 0.02m $AlCl_3$ and 0.04m KCl at 298K. (Given: A = 0.509 at 298 K) 4

ii) Calculate the resting membrane potential for the following: 4

Ion Species	Intracellular concentration in mM	Extracellular concentration in mM
K^+	0.0002	5
Na^+	250	10

(Given that $\frac{2.303RT}{F}$ at 298K = 61)

5. Attempt ***any four*** of the following:

a) Derive the following Maxwell's relation, $\left[\frac{\partial T}{\partial V}\right]_S = -\left[\frac{\partial P}{\partial S}\right]_v$ 3

b) Standard molar entropies depend upon structure of the substance. Give reason. 3

c) What is Hermitian operators? 3

d) Write a note on magnetic quantum number. 3

e) Explain three explosion limits of H_2 and O_2 reaction. 3

f) Explain the principle of microscopic reversibility. 3

g) What is fuel cell? Write any two applications of phosphoric acid fuel cell. 3

h) Write Debye-Huckel-Onsager equation and explain its validity for aqueous solutions. 3

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M.Sc. computer science NEP-2020 Sem 1

Time :2 Hours [Total Marks: 50]

N.B: (1) All questions are compulsory.
(2) Figures to the **right** indicate full marks.
(3) **Assume additional data if necessary** but state the same clearly.
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Q.1 Attempt **any two** of the following **(10)**
a) Define Research. State and explain the characteristics of research.
b) Discus the key components of a Literature Review.
c) Write a short note on Grounded Theory Research.
d) Differentiate between Experimental and Non-Experimental Research.

Q.2 Attempt **any two** of the following **(10)**
a) Explain the following:
i) Research variables
ii) Hypotheses
b) Write a short note on Ethnography.
c) What is Secondary Data Analysis? Explain in brief.
d) Discuss in brief the Data Collection Development Plan.

Q.3 Attempt **any two** of the following **(10)**
a) What is Data Analysis? Explain the importance of Data Analysis in Research.
b) Write a short note on Exploratory Data Analysis (EDA).
c) Explain how to interpret research findings.
d) Discuss the steps involved in Data Analysis.

Q.4 Attempt **any two** of the following **(10)**
a) Write a short note on ethics in research and responsible conduct.
b) Explain how Slide Design can help in preparing effective research presentations.
c) Explain the different types of Peer Review.
d) State and explain the various citation styles.

Q.5 Attempt **any two** of the following **(10)**
a) State the guidelines for formulating Research Questions.
b) Differentiate between Primary and Secondary data for research.
c) Discuss the key challenges in Data Analysis.
d) Write a short note the structure of a research paper

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Q.4A) Attempt any **two** of the following:

(a) State the Jahn Teller theorem. Discuss the interpretation of ESR Spectra of octahedral complex of Cu (II). 4

(b) With respect to complex formation, explain the following evidence:
1) pH metric study. 2)dissolution of insoluble precipitate 4

(c) Draw the orgel diagram for the complex ion $[CrF_6]^{3-}$ and assign the electronic transitions. 4

(d) "The measurement of molar conductance of aqueous solution of cobalt amines compounds helps Werner to assigned correct formulae. Justify the statement. 4

(B) Attempt any **one** of the following:

(a) Describe the potentiometric method for determination of formation constant in complexes. 4

(b) Draw the Orgel diagram for $[Ni(H_2O)_6]^{2+}$. Assign the electronic transitions. 4

Q.5 Attempt any **four** of the following:

(A) Draw the Lewis dot structure of SCN- ion. Give all possible resonating structure and calculate the formal charge. Predict the most stable structure. 3

(B) HF has a smaller heat of vaporization than water. Explain. 3

(C) Explain group multiplication table for water molecule. 3

(D) Define group, sub group and point group with example. 3

(E) Define the terms : 1. Forbidden gap 2. Fermi Energy 3.Semiconductor 3

(F) Give merits and demerits of microwave method in preparation of nanomaterials. 3

(G) ^{31}P NMR spectra shows 1 peak for trans $[PtClBr(PR_3)_2]$ & 2 peaks for the cis $[PtClBr(PR_3)_2]$. Justify. 3

(H) Write a note on Racah parameter. 3