Ex/FET/BS/B/MATH/T/211/2020

BACHELOR OF ENGINEERING EXAMINATION, 2020

(2nd Year, 1st Semester)

MATHEMATICS - III

Time : Three hours

Full Marks : 100

(50 marks for each Part)

Use separate answer-script for each Part.

(Notations and symbols have their usual meanings)

PART -I (50 Marks)

Group - A

Answer any four questions

1a) Show by vector method

$\sin(A-B) = \sin A \cos B - \cos A \sin B$ 3

b) Show that $[\vec{a}+\vec{b},\ \vec{b}+\vec{c},\ \vec{c}+\vec{a}\ ] = 2[\vec{a}\,\vec{b}\,\vec{c}]$ 3

c) A vector field is given by $\vec{f} = (x^2+xy^2)\vec{i} + (y^2+x^2y)\vec{j}$; show that the field is irrotational and find the scalar potential. 3

2a) If $\bar{v} = \bar{\omega} \times \bar{r}$, prove that $\bar{\omega} = \frac{1}{2}\bar{\nabla} \times \bar{v}$ 4

b) Find the directional derivative of $\varphi = 4xz^3 - 3x^2y^2z$ at $(2,-1,2)$ in the direction $2\hat{i} - 3\hat{j} + 6\hat{k}$ 3

c) Show that the Frenet-Serret formula can be written in the form

$\frac{d\vec{t}}{ds} = \vec{w} \times \vec{t},\ \frac{d\vec{n}}{ds} = \vec{w} \times \vec{n},\ \frac{d\vec{b}}{ds} = \vec{w} \times \vec{b}$ and determine $\vec{w}$. 2

3a) Show that $\vec{\nabla}.(\varphi\vec{A}) = (\vec{\nabla}\varphi).\vec{A} + \varphi(\vec{\nabla}.\vec{A})$. 3

b) Show that the necessary and sufficient condition that $u(x,y,z)$, $v(x,y,z)$ and $w(x,y,z)$ be functionally related through the equation is $F(u,v,w) = 0$ is

$[\vec{\nabla}u\ \vec{\nabla}v\ \vec{\nabla}w] = 0.$ 6

4.a) Find the equations for the tangent plane and normal line to the surface $z = x^2 + y^2$ at the point (2,-1, 5). 3

[Turn over

b) State Green's theorem for plane, hence or otherwise evaluate $\int_C e^{-x}(\sin y\, dx + \cos y\, dy)$

where C is the rectangle with vertices $(0,0), (\pi, 0), \left(\pi, \frac{\pi}{2}\right), \left(0, \frac{\pi}{2}\right)$. 6

5a) If $\bar{F} = \bar{\nabla}\varphi$, where φ is single – valued and has continuous partial derivatives, show that the work done in moving a particle from one point $P(x_1, y_1, z_1)$ in this field to another point $Q(x_2, y_2, z_2)$ is independent of the path joining the two points. 3

b) Verify Stokes' theorem for the function $\bar{f} = x^2\,\hat{\imath} + xy\,\hat{\jmath}$, integrated around the square in the plane $z = 0$, whose sides are along the lines $x = 0, x = a, y = 0$ *and* $y = a$. 6

6. Verify the divergence theorem for $\bar{A} = 2x^2y\,\hat{\imath} - y^2\,\hat{\jmath} + 4xz^2\hat{k}$ taken over the region in the first octant bounded by $y^2 + z^2 = 9$ and $x = 2$. 9

Group B

Answer any two questions

7a) Prove that correlation coefficient ρ lies between -1 and +1. 3

b) Find the mean and variance of the Poisson distribution with parameter λ. 4

8a) Let A, B and C be three events such that $P(A) = 0.6$, $P(B) = 0.5$, $P(C) = 0.4$, $P(A \cap B) = 0.3$, $P(A \cap C) = 0.2$, $P(B \cap C) = 0.2$, $P(A \cap B \cap C) = 0.1$, find $P(A \cup B \cup C)$ and $P(A^c \cap B^c \cap C^c)$. 4

b) The integers x and y are chosen at random with replacement from nine natural numbers 1, 2, 3....., 8, 9. Find the probability that $|x^2 - y^2|$ is divisible by 2. 3

9a) In a binomial distribution with parameter $(8, p)$, $P(X = 2) = P(X = 3)$. Find $P(X = 8)$.

b) Two urns contain respectively 2 red, 3 white and 3 red, 5 white balls. One ball is drawn at random from the first urn and transferred into the second. A ball is now drawn from the second urn and it turns out to be red. What is the probability that the transferred ball was white? 3+4

Ref. No.: Ex/FET/BS/B/Math/T/211/2020

B.E Second Year First Semester Examination, 2020

MATHEMATICS III

Full Marks: 100 **Time:** Three hours

(Notations and symbols have their usual meanings)

Use separate answer script for each Part

Part-II

(50 Marks)

Answer any five questions.

Marks will be awarded to the first five attempted questions.

1. Solve the following equations:-

(a) (4)

$$\frac{dy}{dx}\sin x - y\cos x + y^2 = 0$$

(b) (6)

$$(5+2x)^2\frac{d^2y}{dx^2} - 6(5+2x)\frac{dy}{dx} + 8y = 0$$

2. Solve (10)

$$\frac{d^2y}{dx^2} - 4\frac{dy}{dx} + 4y = 8x^2e^{2x}\sin 2x.$$

3. Solve, by the method of variation of parameters, the equation (10)

$$\frac{d^2y}{dx^2} + y = \cos x.$$

Derive the differential equation of the parameters and hence solve it.

4. Find the values of x and y as function of t from the following equations: (10)

$$\frac{dx}{dt} = 4x - 2y$$
$$\frac{dy}{dt} = 5x + 2y$$

Verify your answer.

5. Use Lagrange method to solve the following equations:

(a) (5)

$$(mz - ny)\frac{\partial z}{\partial x} + (nx - lz)\frac{\partial z}{\partial y} = ly - mx$$

(b) (5)

$$z\frac{\partial z}{\partial x} - z\frac{\partial z}{\partial y} = z^2 + (x+y)^2$$

6. Solve (10)

$$\left(\frac{\partial}{\partial x} - \frac{\partial}{\partial y} - 1\right)\left(\frac{\partial}{\partial x} - \frac{\partial}{\partial y} - 2\right)z = \sin(2x + 3y)$$

7. Classify the following equation and solve it by the method of separation of variables (10)

$$\frac{\partial u}{\partial t} = \kappa\frac{\partial^2 u}{\partial x^2}, \qquad \kappa > 0,\ 0 < x < 2\pi,\ t > 0,$$

subject to $u(0,t) = u(2\pi, t) = 0, \quad t \geq 0;$

$u(x, 0) = \sin^3 x, \quad 0 \leq x \leq 2\pi.$

Ref. No. : Ex/ CSE/ PC/ B/ T/ 212/ 2020

B. E. Computer Science and Engineering Second Year First Semester Exam - 2020

DIGITAL LOGIC AND CIRCUITS

Time : 3 Hrs. **Full Marks : 100**

1.	(a) [CO1]	Explain (r-1)'s complement of a number N in base **r** with **n** number of digits. Apply this method to subtract **B** from **A**, where both **A** and **B** are two digit **NBCD** numbers.	2 + 4
	(b) [CO1]	Compare 1's complement and 2's complement representation in the context of binary substraction.	4
	(c) [CO1]	Define minimum distance of a coding system. How many redundant bits are required for single error detection,	2
	(d) [CO1]	Encode the binary number 11011 using Hamming code. Suppose the received codeword is 00101111. Is it possible to detect and correct the error? If yes, then correct the received codeword.	8
		OR	
	(a) [CO1]	Explain with examples the steps for **addition and subtraction** of two numbers represented in **sign-magnitude** form.	6
	(b) [CO1]	Compare **NBCD** and **Excess-3 BCD** in the context of addition / subtraction.	4
	(c) [CO1]	Define Hamming distance between two coded words, Is there any relation between error detection, error correction abilities and minimum distance of a coding system.	3
	(d) [CO1]	Encode the binary number 1001 using Hamming code. Suppose the received codeword is 0011011. Is it possible to detect and correct the error?	7
2.	(a) [CO2]	Summarize different **Boolean Relations and their duals.** Prove De Morgan's laws with the help of Venn diagram.	6+4
	(b) [CO2]	Minimize the following Boolean function using Karnaugh – Veitch Map. $F(A, B, C, D) = \Sigma (0,1,2,7,13,14) + d (3,5,10,15)$ Express the minimized Boolean function in i) Sum-of-Product form ii) Product-of Sum form	10
		OR	
	(a) [CO2]	Minimize the following Boolean function using ~~Karnaugh – Veitch~~ Quinn-McCluskey Map. $F(A, B, C, D, E) = \Sigma (0,4,6,11,13,15,21,25,29) + d (2,9,17,27,31)$ Show all steps clearly.	20

[Turn over

3.	(a) [CO3]	Design a ripple carry adder to add two 3-bit numbers. What is its disadvantage? Suggest a method to overcome it and implement that method.	3+2+3
	(b) [CO3]	Compare between a Mealy machine and a Moore machine. Design a 4 bit sequence generator with sequence pattern shown below: 0000 1 0010 2 0100 3 0110 4 1000 5 1001 6 0111 7 0101 8 0011 9 0001 10 0000 11 Implement it with J-K Master-Slave Flip-flop. Draw the time diagram of each Flip-flop.	2+8+2
		OR	
	(a) [CO3]	Design a NBCD to Gray code converter as follows: NBCD — Gray 0000 — 0000 0001 — 0001 0010 — 0011 0011 — 0010 0100 — 0110 0101 — 0111 0110 — 0101 0111 — 0100 1000 — 1100 1001 — 1101 Show each step clearly. Implement the circuit with NAND gates. Also analyze the functioning of the converter with the help of a truth table.	4+2+2
	(b) [CO3]	A sequential circuit have two level inputs x_1 and x_2 and a clock. An output pulse z is coincident with a clock pulse occurring with $x_1 x_2 = 0\ 1$ immediately following two or more consecutive clock pulses with $x_1 x_2 = 1\ 0$. $x_1 x_2 = 0\ 0$ and $x_1 x_2 = 1\ 1$ never occur. Draw the state diagram and state table for the above circuit requirements. Perform state assignment and implement with T Flip-flops. Draw the final circuit.	2+2+6+2

4.	(a) [CO4]	Draw the circuit diagram of an **RTL NOR** gate and explain its operation. In what way **RTL** differs from **DCTL.** Analyze the pros and cons of **RTL** and **DCTL.**	**10**
	(b) [CO4]	Draw the circuit using **555** timer IC working in astable mode. State the expressions for charging and discharging times and overall duty cycle of the clock pulses.	**10**
		OR	
	(a) [CO4]	Draw the functional diagram of **555** timer IC. Explain its operation.	**12**
	(b) [CO4]	Draw the circuit diagrams of **CMOS NAND** and **NOR** gates. Explain their operations.	**4+4**
5.	(a) [CO5]	Describe sampling theorem. Draw a diagram of a sample-and-hold circuit and explain its operation in the context of Analog to Digital conversion. Draw and explain the operations of a counting type Analog to Digital converter.	**2+4+8**
	(b) [CO5]	Draw and explain an implementation of ROM using Diodes.	**6**
		OR	
	(a) [CO5]	Draw and explain the operations of a **R – 2R** ladder Digital to Analog converter.	**14**
	(b) [CO5]	Draw and explain an implementation of ROM using bipolar transistors.	**6**

Ex/CSE/PC/B/T/215/2020

B.E. Computer Science and Engineering 2nd Year 1st Semester Examination 2020

Subject: Computer Organisation

Time: 3hrs **Full Marks: 100**

Answer any **five**

Answer all the sub-parts of a question in *adjacent* location

1. a. Describe key roles of operating system. 2
   b. Outline the basic steps used in compilation of a program. 3
   c. Sketch the Von-Neumann architecture with very brief discussion about each component. 6
   d. Explain the addressing modes – direct, indirect, and immediate. 3
   e. Describe instruction cycle with all the steps (consider interrupt also). 6

2. a. Develop the instruction sets to execute the expression C=(A*A) + (A*A) by using 1-address and 2-address machines respectively. 3+2
   b. Design the Carry Lookahead adder with mentioning its advantages and limitations. 5
   c. Illustrate the steps to formulate restoring **OR** non-restoring type division with a suitable example. 5+5

3. a. Describe about the read write mechanisms in magnetic disks. 6
   b. Define the disk performance parameters – seek time, rotational delay, access time and transfer time. 4
   c. Illustrate the implementation issues of direct **OR** associative-mapping scheme used in cache memory. Show with a suitable example. 8
   d. State the cache coherence problem. 2

4. a. Discuss about the usage, design and implementation issues of stack. 7
   b. List out the characteristics of horizontal and vertical microinstructions. 3
   c. Formulate the space reduction procedure in Nano-programmed Control Unit. 8
   d. Explain the usage of residual control. 2

[Turn over

5 a. Discuss about the four different categories of device identification techniques in any I/O system. 8

b. Tell about the merits and demerits of DMA (direct memory access) I/O technique. 2

c. Point out the pre-requisites of pipeline architecture. 2

d. Illustrate some problems and corresponding solutions related to instruction hazard. 8

6 Discuss about the following (any two): 10x2

(a) Soft error correction method

(b) RAID level

(c) Wilkes's Design

(d) Pipeline in Superscalar processor

Detail of CO:
CO1: Q1 (a, b, c) (Marks: 11)
CO2: Q1 (d, e), Q2 (a) (Marks: 9+5)
CO3: Q2 (b, c), Q6 (a) (Marks: 15+10)
CO4: Q3 (all), Q6 (b) (Marks: 20+10)
CO5: Q4 (all), Q6 (c) (Marks: 20+10)
CO6: Q5 (all), Q6 (d) (Marks: 20+10)

Ref. No. Ex/CSE/PC/B/T/214/2020

BCSE 2nd Year 1st Semester Examination, 2020

Programming Fundamentals and Object Oriented Concepts

Full marks: 100 **Time: 3 hours**

Group A [CO1]: 15 Marks

malloc - check

Attempt any one

1) a) In C, what is the utility of functions and discuss parameter passing techniques. 5

b) In main() of a C program, ptr is a variable of type int**. Write a function to allocate memory for r number of rows and c number of columns and thereafter in main(), ptr[i][j] should be able to access element at i-th row and j-th column. 6

c) Write your own function in C language to copy string (do not use strcpy()). Source and destination are to be passed as arguments. 4

2) a) Compare array and structure. 2

b) In a suitable array store the roll, name and score in three subjects for number of students. Write a function to sort the students in the descending order of total score. 7

c) Suppose, we need to store a table where row denotes sample number and column denotes reading. It is known that for every sample five readings are taken. But, how many samples are there is known only when entering reading values (these are of type int). Write the code in C to handle the scenario. To store data of table, space wastage is not allowed. 6

Group B [CO2]: 15 Marks

3) a) In C language, how will you create a binary file of records with fixed length? How can you find number of records in the file? 5

b) Consider, STOCK file contains item-code, item name and quantity available for different items handled by a company. Item-codes are running integer like 1,2,3 ….. n. Records are sorted in the ascending order of item-code. TRANSACTION file stores item-code, quantity and trans-type (if it is S then quantity has been sold, if R then quantity has been received). Assume, files are of type binary and records are of fixed length. Write the program in C to update the quantity available in STOCK file using the records of TRANSACTION file. Note, sell reduces available quantity and receiving increases the same. 10

[Turn over

Group C [CO3]: 30 Marks

Attempt any two

4) a) Explain encapsulation, inheritance and polymorphism in the context of object oriented programming. 6

b) State the utility of static members in a class. 3

c) Consider, x, y and z are objects of a class and i is an integer. Explain what minimal action you will take to support the following.

x=i; i=x; x=y+5; z=x+y; i=x+y; 3

d) Why do we need virtual destructor? 3

5) a) Comment on the size of an object in C++. 3

b) Specify the use of friend function. 3

c) Consider, class A has two virtual public member functions f1(void) and f2(void). B has been derived from A in public mode. In B, there are two public functions f1(int) and f2(void). Consider the following codes:

A *p; B b; p=&b;

Explain which functions will be called for the following:

i) p→f1() ii) p→f2() iii) p→f1(10) iv) b.f1() 6

d) System provides the copy constructor; still one may like to write a copy constructor. Why? 3

6) a) Compare function overloading and function overriding. 3

b) As programmer, what will you do to achieve runtime polymorphism? How does system implement support it? 6

c) What is the utility of abstract class? 3

d) Write short notes on exception handling. 3

Group D[CO4]: 30 Marks

Attempt any two

7) a) In a library of an institute each member has unique member-id, name, phone number and e-mail id. Member may be a student, faculty or other employee of the institute. For the students roll number, department and course are to be stored. For faculty and other employees employee id, department are to be stored. Maximum number of books to be issued, period of issue, late return charges vary for different category of members. A member may like to update and view his details, submit book issue and return requests. The requests will be processed by the system according to certain policy which is not within the current scope. One may also like to view as per his/her category what are

maximum number of books to be issued, period of issue, late return charges. **Design the classes (no code is required).** 5

b) Consider the following system:

Name of the students (maximum 100 students) are kept in a list. Another list is there to store information about projects (maximum 10 projects) like, project name, number of students required and number of students actually allotted so far in each project. A student can work in at most one project whereas number of students may work in a project. During allotment process, where to allot (*i.e.* project name) and whom to allot (*i.e.* student name) are taken as input. For allotment, student must not be already allotted and project must have number of already allotted students less than students required. System must be able to show which student is allotted in which project and who are the students working in a project.

Design the necessary classes [Do not consider any file/ STL classes] and write the complete code. 10

8) a) In an institute, each student has unique class roll number. During examination unique examination roll number is also assigned to each student. The mapping between class roll and exam roll number is maintained at the examination controller's office. Evaluator submits score-sheet containing the examination roll number and score of all students. **Design the classes (no code is required)** for the system with the following scope: system can store score sheet, mapping, given the examination roll number one can find the class roll number, given a class roll number one can find the score. 5

b) Design the class(es) to store information of all the students (maximum, say 50 students). **[Do not consider any file/ STL classes.]** For each student roll, name and score is to be stored. The desired functionalities are: i) to show details of the student corresponding to a given roll ii) to update score of the student corresponding to a given roll iii) to show the details of topper(s) and iv) to find the average score. While doing an operation for a particular roll, if it does not exist then error message is to be displayed. Also design a class *resultinterface* with static function *opertaionmenu()* to work with the system.

Design the classes and Write down the complete code. 10

9) Information (itemcode, itemname, price) of the items are to be stored in a file. Itemcode must be unique. User can add record (maintaining the uniqueness of itemcode), retrieve the price for a given itemcode, can update the price for an itemcode, can show the names of costliest item(s). While doing operation for a given itemcode if it not found suitable message is to be displayed.

Design the classes and implement write down the complete code. 15

Group E [CO5]: 10 Marks

Attempt any one

10) a) What is the use of function template and class template? 3

b) In STL of C++, What is an adapter? Explain with example. 3

c) Roll (unique) and score of the students are to be stored. Very frequently, score is to be retrieved for a given roll. Use suitable class from STL and write the code to store data and find score for a roll. 4

11) a) Use suitable STL class to store name and age of number of persons in a linked list. One should be able to add data, display all data, sort the list in the descending order of age and merge two such lists. **Design the classes and write the code.** 8

b) What is the fundamental difference between a map and hashmap? 2

CSE/PC/B/T/213/2020

B. E. COMPUTER SC. & ENGINEERING EXAMINATION, 2020

(2nd Year, 1st Semester)

DATA STRUCTURES AND ALGORITHMS

Time : Three hours **Full Marks : 100**

Answer all questions. Be brief and to the point in answering questions.

1. (a) What do you mean by Abstract Data Type? Explain with the help of C language *struct* type. 2+3

(b) What are the basic algorithmic structures used in high level procedural languages? Describe with flow-charts. 5

(c) What is the difference between Binary Recursion and Non-linear Recursion? 3

(d) Show how a general n-ary tree can be represented unambiguously by a binary structure. 3

(e) What is the lower bound on the time complexity of any comparison-based sorting algorithm? Name a comparison based sorting algorithm which is ~~not~~ linear-time in a special case. Explain its usage in the special case. 4

2. Answer any two from the following:

(a) Write C language functions for *insert_after* and *delete_after* functions for a Circular Singly Linked List with a tail pointer. You need to define the node types also. Hence write the C functions *enqueue* and *dequeue* for a Queue implemented using the Circular Single Linked List. 4+2+4

(b) Develop a sorting algorithm which does not use comparisons and runs in linear time. What are the constraints on the elements of the array to be sorted by such an algorithm? Write a C function for the sorting algorithm you proposed. Explain how the following array will be sorted in increasing order by the algorithm:

5 3 1 2 5 3 1 2 6 4 1 2 6 4 8 9

3+1+3+3

(c) Explain the Folding Hash function. Write a C language function to compute the hash value for character strings using the concept of folding considering the length of strings to be 20 character and 4 folds to be used. 3+7

3. Answer any two from the following:

(a) Design an algorithm for computing n^{th} Fibonacci number following the Dynamic Programming approach. Explain clearly the rationale of Dynamic Programming and relate to your algorithm. 4+6

(b) Design a greedy algorithm to find out the Minimum Cost Spanning Tree of a Graph. Explain how the greedy strategy has been used in your algorithm. Analyze the time complexity of your algorithm. 4+3+3

[Turn over

(c) Explain the Divide and Conquer strategy for algorithm development. Develop a sorting algorithm using the Divide and Conquer strategy. Present an informal time complexity of your algorithm.

2+4+4

4. Answer any two from the following:

(a) Discuss various Data Structures which can be used to solve the n-queens problem. Explain the space complexity of each of the alternatives. What is the usual method of solving the n-queens problem? How can you make it faster?

4+3+3

(b) What is the post-fix notation of representation of arithmetic expression? Develop an algorithm for evaluation of such expressions. What are the errors which can be detected by your algorithm? Find out the time and space complexities of the algorithm.

2+3+2+3

(c) Define a B-Tree. Why is a B-Tree not very useful for storing and manipulating large volume of data in Hard disk? What changes have been made in B Tree to formulate the B+ Tree? Show a rough calculation to find the amount of records which can be processed using a 4 level B+ Tree.

3+1+3+3

5. Answer any two from the following:

(a) In solving a problem, each data node has a structure containing some information field. The total number of bytes in the structure is 1056. You have a maximum of 10,000 such structures to process. The different options of data structures are array, single linked list and double linked list. Considering each pointer has 6 bytes, what is the memory overhead if you want to process all 10,000 structures in memory? Explain situations, when you will select each data structure options.

4+6

(b) You have a very large number of names, each having at most 50 characters, in a file. In an application, the names will be input to the system, and it is required to search the names extremely fast. Explain your choice of data structure for the application. Explain how the names will be actually searched. Is there a chance of false positive or false negative in your proposed method? Explain.

3+5+2

(c) In an application, you need to store the information in a binary tree where frequent in-order traversals are necessary. Explain the choice of your data structure. What are the memory overhead and the savings in the time complexity? Explain by with reference to the traversal algorithm.

3+4+3

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