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BTECH
(SEM III) THEORY EXAMINATION 2023-24
MATHEMATICS-III

TIME: 3HRS

M.MARKS: 100

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt all questions in brief.

2 x 10 = 20

Q no.	Question	Marks	CO
a.	Find the Laplace transform of $te^t \sin 2t$.	2	1
b.	State convolution theorem on Laplace transform.	2	1
c.	Describe two properties of Fourier transform.	2	2
d.	Find the Fourier Cosine transform of e^{-ax} .	2	2
e.	Check whether $(p \wedge \neg q) \vee (p \vee q)$ is Tautology or not.	2	3
f.	Find a multiplicative inverse of 8 modulo 15.	2	3
g.	State the reason for the relation R in the set $\{1, 2, 3\}$ given by $R = \{(1, 2), (2, 1)\}$ not to be transitive.	2	4
h.	What is Pigeonhole Principle?	2	4
i.	Describe bounded lattice with an example.	2	5
j.	Describe Partially Ordered set with an example.	2	5

SECTION B

2. Attempt any three of the following:

10 x 3 = 30

a.	Using Laplace transform, solve the differential equation $y''(t) - 3y'(t) + 2y(t) = 4t + e^{3t}$ where $y(0) = 1, y'(0) = -1$.	10	1
b.	State and prove the convolution theorem for Fourier Transforms.	10	2
c.	Show that every cyclic group is an abelian group and also explain Monoid with an example.	10	3
d.	In a group of 100 students, 72 students can speak English and 43 students can speak Hindi. Based on these data, answer the following questions: Find the number of students who can speak English only. a. Find the number of students who can speak Hindi only. b. Find the number of students who can speak both English and Hindi.	10	4
e.	Minimize the following Boolean function $F(A, B, C, D) = \Sigma(0, 1, 3, 5, 7, 8, 9, 11, 13, 15)$.	10	5

SECTION C

3. Attempt any one part of the following:

10 x 1 = 10

a.	Find the Laplace transform of $f(t) = \begin{cases} t; & 0 \leq t \leq a \\ 2a - t; & a \leq t \leq 2a \end{cases}$ given that $f(t + 2a) = f(t)$.	10	1
b.	Find $L^{-1} \left[s \log \left(\frac{s^2 + a^2}{s^2 + b^2} \right) \right]$.	10	1



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4. Attempt any one part of the following: 10 x 1 = 10

a.	Determine the distribution of the temperature by solving the equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$, subject to the conditions (i) $u = 0, x = 0, t > 0$ (ii) $u = \begin{cases} 2, & 0 < x < 1 \\ 0, & x \geq 1 \end{cases}$ when $t = 0$ (iii) $u(x, t)$ is bounded.	10	2
b.	Evaluate the solution of the difference equation by Z-transform: $y_{k+1} - 2y_k = 1, k \geq 0, y(0) = 1.$	10	2

5. Attempt any one part of the following: 10 x 1 = 10

a.	"If I will study discrete math, then I will study computer science." "If I will study protein structures, then I will study biochemistry." "I will not study computer science or I will not study biochemistry." "Therefore, I will not study discrete math or I will not study protein structures."	10	3
b.	Are the statements $p \rightarrow (q \vee r)$ and $(p \rightarrow q) \vee (p \rightarrow r)$ logically equivalent?	10	3

6. Attempt any one part of the following: 10 x 1 = 10

a.	Prove the following formula using the Principle of Mathematical Induction. $1^2 + 3^2 + 5^2 + \dots (2n - 1)^2 = n(2n - 1)(2n + 1)/3.$	10	4
b.	Solve the recurrence relation $a_{n+2} - 3a_{n+1} + 2a_n = 0$ by the method of generating function with the initial conditions $a_0 = 2, a_1 = 3.$	10	4

7. Attempt any one part of the following: 10 x 1 = 10

a.	Discuss De Morgan's laws and prove it.	10	5
b.	Obtain DNF of $q \vee (p \wedge r) \wedge \neg((p \vee r) \wedge q).$	10	5