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BTECH
(SEM III) THEORY EXAMINATION 2024-25
MATHEMATICS-III

TIME: 3 HRS

M.MARKS: 100

Note: Attempt all Sections. In case of any missing data; choose suitably.

SECTION A

1. Attempt all questions in brief.

2 x 10 = 20

Q no.	Question	CO	Level
a.	Evaluate $L[e^{-t}]$	1	K ₃
b.	Find the inverse Laplace transform of $\frac{1}{(s^2-4)}$.	1	K ₁
c.	Find the Fourier Sine transform of $\frac{e^{-ax}}{x}$	2	K ₂
d.	Find Z-transform of $\sin 2k$ for $k \geq 0$.	2	K ₁
e.	Define Field with example.	3	K ₂
f.	Define permutation group.	3	K ₁
g.	Let $A = \{1,2,3,4,5\}$ and $R = \{(1,2), (1,1), (2,1), (2,2), (3,3), (4,4), (4,5), (5,4), (5,5)\}$ be an equivalence relation on A, find R^{-1} .	4	K ₂
h.	What is Pigeonhole Principle?	4	K ₁
i.	State De Morgan's theorem.	5	K ₃
j.	Define Partially ordered set.	5	K ₂

SECTION B

2. Attempt any three of the following:

10 x 3 = 30

a.	Using Convolution theorem to evaluate $L^{-1} \left[\frac{1}{(s^2+a^2)^2} \right]$	1	K ₁
b.	Use Fourier Sine transform to solve the equation $\frac{\partial u}{\partial t} = k \frac{\partial^2 u}{\partial x^2}$ under the condition (i) $u(0, t) = 0$, (ii) $u(x, 0) = e^{-x}$ (iii) $u(x, t)$ is bounded.	2	K ₅
c.	If two operation * and o on the set Z of integers are defined as follows $a * b = a+b-1$, $a o b = a+b-ab$. Prove that $(Z, *, o)$ is a commutative ring with unity element.	3	K ₃
d.	Solve the recurrence relation $a_{r+2} - 2a_{r+1} + a_r = 2^r$ by the method of generating function with the initial condition $a_0 = 2, a_1 = 1$.	4	K ₅
e.	Consider the Poset $A = (\{1,2,3,4,6,9,12,18,36\}, /)$, find the greatest lower bound and the least upper bound of the set $\{6,18\}$ and $\{4,6,9\}$	5	K ₃

SECTION C

3. Attempt any one part of the following:

10 x 1 = 10

a.	Using Laplace transformation to solve the following differential equation: $y'' + 25y = 10 \cos 5t$; $y(0) = 2, y'(0) = 0$.	1	K ₅
b.	Find the Laplace transform of $f(t) = t e^{-t} \sin 2t$.	1	K ₃

4. Attempt any one part of the following:

10 x 1 = 10

a.	Solve the differential equation $y_{k+3} - 3y_{k+2} + 3y_{k+1} - y_k = U(k)$ $y(0) = y(1) = y(2) = 0$, by Z-transform.	2	K ₃
b.	Find the Fourier transform of e^{-ax^2} , where $a > 0$.	2	K ₁



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

a.	Prove that following propositions are tautology i) $\sim(p \wedge q) \vee q$ ii) $p \Rightarrow (p \vee q)$	3	K ₂
b.	Prove that the order of each sub group of a finite group G is a divisor of the order of the group G.	3	K ₃

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

a.	Let the function $f: \mathbb{R} \rightarrow \mathbb{R}$ defined by $f(x) =$ $\begin{cases} 3x - 1 & \text{for } x > 3 \\ 2x^2 + 3 & \text{for } -2 < x \leq 3, \\ 3x^2 - 7 & \text{for } x \leq -2 \end{cases}$ Find $f^{-1}(5)$	4	K ₃
b.	Out of 250, candidate who failed in an examination, it was revealed that 128 failed in Maths, 87 failed in Physics, and 134 failed in Chemistry. 31 failed in both Maths & Physics, 54 failed in chemistry & Maths, 30 failed in Chemistry & Physics. Find how many candidate failed in (a) all the three subjects (b) Maths but not in Physics (c) Chemistry but not in Maths (d) Physics but not in Chemistry or in Maths (e) Chemistry or in Maths, but not in Physics.	4	K ₅

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

a.	Prove that product of two lattices is a lattice.	5	K ₂
b.	Define i) upper and lower bounds ii) Distributive Lattices iii) Logic Gates	5	K ₁