ADITYA UNIVERSITY

(Formerly known as Aditya Engineering College (A))

000385

PART-I

S.No: 421925

Programe : B.TECH

Hall Ticket No: 21A91A0339

Name : SIDDANATI DILEEP KUMAR

Examination : III SEMESTER SUPPLEMENTARY (AR20)

Month-Year : Nov/Dec 2025

Branch : MECHANICAL ENGINEERING

Course Code : 201BS3T12

Course Name : Integral transforms & applications of Partial Differential Equations

Date of Exam : 18-11-2025

J. Pavan.

Signature of the Controller of Examination

S. Dilip Kumar 18/11/2025

Signature of the Student with date

M. Sai Chaitanya 18/11/25

Signature of the Invigilator with date

Serial No. Last Page Written	15

INSTRUCTIONS TO STUDENTS

1. The Answer Booklet contains 36 pages Ensure all the 36 pages are in proper order.
2. Student must verify the details of particulars in the PART - 1 i.e Name, Hall Ticket No., Examination, Course Name etc.,
3. In case of any deviation in the above or if the PART-1 is torn / damaged, report to the invigilator and return the damaged booklet.
4. You are prohibited from writing on or tampering the PART-1 except affixing the signature and serial number of last page written in the space provided.
5. Student is prohibited from:
   i. Writing their Hall Ticket No. and name in any part of the answer booklet.
   ii. Addressing the examiner in any manner whatsoever in the answer booklet. If they do so, their script will not be valued.
   iii. Writing religious symbols.
   iv. Either seeking or providing any assistance to the fellow students in the examinations.
   v. Possessing a manuscript or a printed matter, in any form, in the examination hall.
   vi. Bringing Mobile Phones / Cameras/ Bluetooth Devices / Programmable calculators etc.
   vii. Violation of the above mentioned instructions will be viewed as a case of malpractice, which is punishable offence.
6. Before beginning to answer any question, the students should write the correct number of that question in the margin provided. Answers written at different places for the same question will not be valued.
7. Students should write the answers, within the margins provided on both sides of the paper and on all the lines of each page. It is not necessary to begin each answer in a fresh page. Answers must be legibly written with blue or black pen.
8. Do not write anything except Question Number in the margin.
9. No loose sheets of papers will be allowed in the examination hall. No paper must be detached from or attached to the answer booklet except graph sheet.
10. Strike off all unused pages.
11. **NO ADDITIONAL ANSWER BOOKLETS/SHEETS WILL BE SUPPLIED.**

SPACE FOR ROUGH WORK

$\partial u = (x'(x) \quad : \partial u = y'(y)$

$\Rightarrow a_0 = \frac{1}{\pi} \int f(x)\, dx$

$= \frac{1}{\pi} \int f(x) \cos nx\, dx$

Q.No.

9 a <u>Solve</u>:

Let $u(X(x)Y(y)$ is using to solve differential equation —①

$$\partial u = (X(x) \quad \& \quad \partial u = (T(t)$$

Now separation differential equation w.r.t a x & t.

$$\partial u = \frac{\partial u}{\partial x} X(x) \quad \& \quad \partial u = \frac{\partial u}{\partial t} T(t)$$

Now subtitude in value.

$$X'(X)T(t) = 2X(x)T'(t) + X(x)T(t)$$

$$X'(x)T(t) = X(x)T'(t) + X(x)T(t)$$

$$\frac{X'(X)}{X(x)} = X(x)[2T'(t) + T(t)]$$

$$= \frac{2T'(t) + T(t)}{T(t)}$$

$$\boxed{\frac{X'(x)}{X(x)} = K} \quad \& \quad \boxed{\frac{2T'(t) + T(t)}{T(t)} = K}$$

Q.No.

$$\frac{X'(x)}{X(x)} = \frac{2T'(t)+T(t)}{T(t)}$$

$$X'(x) = K\,T(t)$$

$$X'(x) - K\,T(t) = 0$$

$$\cancel{X'(x)}$$

$$(1D - K) = 0$$

$$m - K = 0$$

$$m = K$$

$$= C_1 C_2 e^{Kx}$$

$$\frac{2T'(t)\,T(t)}{T(t)}$$

$$2T'(t)\,T(t) = K\,T(t)$$

$$2T'(t)\,T(t) - K\,T(t) = 0$$

$$2T'(t) = K\,T(t)$$

$$2(D - K) = 0$$

$$2m - K = 0$$

$$\boxed{m = \left(\frac{Kx}{2}\right)t}$$

$$= C_1 C_2 e^{\left(\frac{Kx}{2}\right)t}$$

NOW.

$$= C_1 C_2' e^{Kx} \qquad = C_1 C_2 e^{\frac{Kx}{2}}$$

$$= C_1 C_2 e^{Kx + \left(\frac{Kx}{2}\right)t}$$

Given $u(x,0) = 6e^{-3x}$

$$6e^{-3x} = C_1 C_2 e^{Kx + \left(\frac{Kx}{2}\right)t}$$

$$C_1 C_2 = 6$$

$$K = -3$$

$$= 6e^{-3x - 2t}$$

Q.No.

7 b) <u>convolution</u> <u>Theorem</u>:

$$L^{-1}\left\{\frac{s^2}{(s^2+4)(s^2+9)}\right\}$$

<u>Solve</u>:

$$= L^{-1}\left\{\frac{s^2}{(s^2+4)}\right\} = L^{-1}\left\{\frac{s^2}{(s^2+9)}\right.$$

$$= L^{-1}\left\{\frac{s^2}{(s^2+2^2}\right\} = L^{-1}\left\{\frac{s^2}{(s^2+3^2)}\right\}$$

$$F(s) = L^{-1}\left\{\frac{s^2}{(s^2+2^2}\right\} = \cos 2t$$

$$g(s) = L^{-1}\left\{\frac{s^2}{(s^2+3^2)}\right\} = \cos 3t$$

$$F(s) = \cos 2t \qquad g(s) = \cos 3t.$$

Formula

$$\boxed{F(s)\,g(s) = F(s) * g(s) = \int F(u)\,g(t-u)}$$

$$= \int \cos 3(u) \cos 3(t-u)$$

$$= \int \cos(2) \cos(3-2)$$

$$= \int \cos[2+3-2] + \cos[2-3+2]$$

Q.No.

$$= \int (\cos[u+3t] \cdot \cos[4u-3t]$$

$$= \left[\frac{\sin[u+3t]}{t} - \frac{\sin[4u-3t]}{4}\right]_0^t$$

$$= [\sin[t+3t] - \sin[4t-3t] +$$

$$[\sin(+3t] - [\sin(-3t)]$$

$$= \left[\frac{\sin[t+3t]}{t} - \frac{\sin(4t-3t)}{4}\right.$$

$$+ \frac{\sin 3t}{3} - \frac{\sin(-3t)}{3}$$

$$= \frac{1}{t}\sin(t+3t) - \frac{1}{4}\sin(4t-3t)$$

$$+ \left(\frac{1}{3}\sin 3t - \frac{1}{3}\sin(3t)\right)$$

$$= \frac{t\sin 3t + \sin t - 4\sin 4t + \sin 3t}{3\sin 3t + 3\sin 3t.}$$

21

Q.No.

1 b) solve:-

$$F(x) = x \cos x \qquad (-\pi, \pi)$$

Formulas

$$a_0 = \int_{-\pi}^{\pi} F(x)\, dx$$

$$a_n = \int_{-\pi}^{\pi} F(x) \cos \frac{n\pi x}{l}\, dx$$

$$b_n = \int_{-\pi}^{\pi} F(x) \sin \frac{n\pi x}{l}\, dx$$

Find the a_0:- $uv / u. \int v. \int u \frac{\partial}{\partial x} v.$

$$a_0 = \frac{1}{\pi} \int_{-\pi}^{\pi} F(x)\, dx$$

$$= \frac{1}{\pi} \int_{-\pi}^{\pi} x \cos x$$

$$= \frac{1}{\pi} \int_{-\pi}^{\pi} x \cos x \int_{-\pi}^{\pi} x \cos x$$

$$= \frac{1}{\pi} \int x \frac{\sin x}{n} \int 1. \frac{\cos x}{n^2}$$

$$= \left[\left(\pi \frac{\sin \pi}{(1+n)} \right) - \left(\frac{\cos \pi}{(1+n)} \right) \right] + \left[-\pi \left(\sin -\pi \right) - \left(\frac{\cos -\pi}{(1+n)} \right) \right]$$

$$= \frac{1}{\pi} \left[\frac{1}{(1+n)} + \frac{1}{(1+n)} \right]$$

$2 \sin \cos = 2 \sin(A+B)$

$\cos \sin = 2 \sin(A-B)$

Q.No.

$$\boxed{a_0 = \frac{\pi^2}{(1+n)}}$$

<u>to Find the a_n</u> :-

$$F(x) = x \cos x$$

$$a_n = \int_{-\pi}^{\pi} F(x) \cos \frac{n\pi x}{\pi} \, dx$$

$$a_n = \frac{1}{\pi} \int_{-\pi}^{\pi} x \cos x \cos \frac{n\pi x}{l} \, dx.$$

$$a_n = \int_{-\pi}^{\pi} x \cos(A-B) - \cos(A+B)$$

$$a_n = \int_{-\pi}^{\pi} \sin\left[x + \frac{n\pi x}{l}\right] - \cos$$

$$\left[x - \frac{n\pi x}{l}\right]$$

$$a_n = \int_{-\pi}^{\pi} \cos\left(-\pi + \frac{n\pi^2}{l}\right) \cos\left[-\pi - \frac{n\pi^2}{l}\right]$$

$$+ \cos\left[\pi + \frac{n\pi^2}{l}\right] \cos\left[\pi - \frac{n\pi^2}{l}\right]$$

$$= \frac{1}{\pi}\left[\left(\frac{1}{(n-\pi^2)}\right) - \left(\frac{1}{(n-\pi^2)}\right) + \frac{1}{n\pi^2} - \frac{1}{n\pi^2}\right.$$

$$a_0 = \frac{1}{\pi} \frac{2}{(n-\pi^2)}$$

Q.No.

Find the b_n:-

$$b_n = \int_{-\pi}^{\pi} x \cos x \sin \frac{n\pi x}{\pi} \, dx.$$

$$= \int_{-\pi}^{\pi} \sin(A-B) - \sin(A+B)$$

$$= \int_{-\pi}^{\pi} \left(\sin\left[x - \frac{n\pi x}{\pi}\right] - \sin\left[x + \frac{n\pi x}{\pi}\right]\right)$$

$$= \frac{1}{\pi}\left[\sin\left(x - \frac{n\pi x}{\pi}\right)\right] - \sin\left(x + \frac{n\pi x}{\pi}\right]_{-\pi}^{\pi}$$

$$= \frac{1}{\pi}\left[\sin\left(-\pi - \frac{n\pi^2}{\pi}\right) - \sin\left(-\pi + \frac{n\pi^2}{\pi}\right)\right]$$

$$+ \left[\sin\left[\pi - \frac{n\pi^2}{\pi}\right] - \sin\left[\pi + \frac{n\pi^2}{\pi}\right]\right]$$

$$= \frac{1}{\pi}\left[\sin(-\pi - n\pi^2)^{=0} - \sin(-\pi + n\pi^2)^{=0} + \sin(\pi - n\pi^2)^{=0} - \sin[\pi + n\pi^2]^{=0}\right]$$

$$\boxed{b_n = 0}$$

Find the b_n:- $F(x) = x \cos x$

$= \cos^2 x$

Q.No.

1 A) Solve:-

$$F(x) = \begin{cases} x & (0 < 3) \\ 6 - x & (3 \; x, 6) \end{cases}$$

Formulas:-

$$a_0 = \int_0^3 F(x)\, dx$$

$$a_n = \int_0^3 F(x) \cos nx \, dx$$

$$b_n = \int_0^3 F(x) \sin nx \, dx.$$

Find the a_0:-

$$a_0 = \int_0^3 F(x)\, dx$$

$$a_0 = \frac{1}{\pi} \int_0^3 x \int_3^6 6 - x$$

$$a_0 = \frac{1}{\pi} \left[\frac{x^2}{2} \right]_0^3 - \left[6 - \frac{x^2}{2} \right]_3^6$$

$$a_0 = \frac{1}{\pi} \left[\frac{3^2}{2} \right] - \left[6 - \frac{3^2}{2} \right] - \left[6 - \frac{6^2}{2} \right]$$

$$a_0 = \frac{1}{\pi} \left[\frac{9^2}{2} \right] - \left[6 - \frac{9^2}{2} \right] - \left[6 - \frac{36^2}{2} \right]$$

$$\boxed{a_0 = \frac{1}{\pi} \frac{36}{12}}$$

Q.No.

Fin the a_n:-

$$= \int_0^3 F(x) \cos nx \, dx$$

$$= \int_0^3 x \int_3^6 \underbrace{6-x}_{u} \underbrace{\cos nx}_{v} \, dx$$

$$= \int_0^3 1 \int_3^6 6-x \; \frac{\sin nx}{n} - \int 6 \cdot x \; \frac{\sin nx}{n}$$

$$= \frac{1}{\pi} \left[6-x \; \frac{\sin nx}{n} - 6 \; \frac{\cos nx}{n^2} \right]_3^6$$

$$= \frac{1}{\pi} \left[6-3 \; \frac{\sin n3}{n} - 6 \; \frac{\cos n3}{n^2} \right]$$

$$- \left[6-6 \; \frac{\sin 6}{n^3} - 6 \; \frac{\cos n6}{n^4} \right]$$

$$= \frac{1}{\pi} \left[\frac{3}{n} \cancel{\sin n3}^{=0} - \frac{6}{n^2} \cos n3 + \frac{1}{n^3} \right.$$

$$\left. \cancel{\sin 6}^{=0} - \frac{6}{n^4} \cos n6 \right]$$

$$= \frac{1}{\pi} \left[\frac{6}{n^2} (1) + \frac{6}{n^2} (1) \right]$$

$$a_0 = \frac{1}{\pi} \left[\frac{12}{n^2} \right]$$

$$=$$

Q.No.

$$b_n = \int_0^3 F(x) \sin nx \, dx$$

$$= \int_0^3 x \int_3^6 6-x \sin nx \, dx$$

$$= \frac{1}{\pi} \int_0^3 1 \int_3^6 6-x \, \cos nx \, dx$$

$$= \frac{1}{\pi} \int_0^3 1 \int_3^6 6-x \, \frac{\cos nx}{n} \int_3^6 6 \cdot \left(\frac{\sin nx}{n^2}\right)$$

$$= \frac{1}{\pi} \left[6-x \, \frac{\cos nx}{n} - 6 \left(\frac{\sin nx}{n^2}\right) \right]_3^6$$

$$= \frac{1}{\pi} \left[6 - 3 \, \frac{\cos n3}{n} - 6 \, \frac{\sin n3}{n^2} + 6 - 6 \, \frac{\cos n6}{n} - 6 \, \frac{\sin n6}{n^2} \right] dx$$

$$= \frac{1}{\pi} \left[\frac{3}{n} \cos n3 - \cancel{\frac{6 \sin n3}{n^2}}^{=0} + \frac{\cos n6}{n} - \cancel{\frac{6 \sin n6}{n^4}}^{=0} \right]$$

$$= \frac{1}{\pi} \left[\frac{3}{n} \right.$$

$$\boxed{b_n = \frac{3}{\pi n}}$$

Q.No.

7 A) <u>solve:-</u>

$$L^{-1}\left\{\frac{2s-3}{s^2+4s+13}\right\}$$

$$L^{-1}\left\{\frac{2}{s^2+4}\right\} = L^{-1}\left\{\frac{1}{s+13}\right\}$$

$$L^{-1}\left\{\frac{2}{s^2+2^2}\right\} = L^{-1}\frac{1}{-3}\left\{\frac{1}{s+13}\right\}$$

$$L^{-1}\left\{\sin 2t\right\} = L^{-1}\frac{1}{-3} = e^{-13t}$$

$$\boxed{L^{-1}(\sin 2t) \quad L^{-1} = \frac{1}{-3}e^{-13t}}$$

Q.No.

$a^3 + 3a^2b + 3ab^2 + b^3$

$s^3 + 3s^2 3 + 3s3^2 + 3^3$

6 A) <u>solve:</u>

$$L\{t^2 e^{-3t} \sin 2t\}$$

$$L\{t^2\} = L\{e^{-3t}\} = L\{\sin 2t\}$$

$$L\left\{\frac{2!}{s^{2+1}}\right\} = L\left\{\frac{1}{s+3}\right\} = L\left[\frac{2}{(s^2+2^2)}\right]$$

$$= L\left[\frac{2!}{s^3}\right] = L\left[\frac{1}{s+3}\right] = L\left[\frac{2}{(s^2+4)}\right]$$

shifting

$$= L\left[\frac{2!}{(s+3)^3}\right] + L\left[\frac{1}{(s+3)+3}\right] = L\left[\frac{2}{(s+3)^2+4}\right]$$

$(-(s+3))$

$$= L\left[\frac{2!}{s^3+3s^2 3+3s3^2+3^3}\right] + \left[\frac{1}{3s+9}\right]$$

$$- \left[\frac{2}{s^2+3^2+2s3+4}\right]$$

$$= L\left[\frac{2}{s^3+6s^3+9+18}\right] L\left\{\frac{1}{3s+9}\right\}$$

$$+ L\left[\frac{2}{s^2+9+s6+4}\right]$$

Q.No.

$$= L\left[\frac{2}{s^3+6s^2+27}\right] - L\left[\frac{1}{3s+9}\right] + L\left[\frac{2}{s^2+s6+97}\right]$$

6 b) solve:-

$$= \int_0^\infty \frac{\cos 6t \ \cos 4t}{t}.$$

$$L = \frac{1}{t}\left\{\cos 6t\right\} \ L\left\{\cos 4t\right\}$$

$$L = \frac{1}{t}\left\{\frac{s}{(s^2+6^2)}\right\} - L\left\{\frac{s}{(s^2+4^2}\right\}$$

$$L = \frac{1}{t}\left\{\frac{s}{(s^2+36)}\right\} \ L\left\{\frac{s}{(s^2+16)}\right\}$$

$$L = \frac{1}{t}\left\{\frac{s\,(s^2+16)+s\,(s^2+36)}{(s^2+36)\,(s^2+16)}\right\}$$

$$L = \frac{1}{t}\left\{\frac{s^3+s16+s^3+s36}{(s^2+36)\,(s^2+16)}\right\}$$

$$= \frac{1}{t}\left\{\frac{2s^3+s16+s52}{(s^2+36)\,(s^2+16)}\right\}$$

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SEMI-LOG PAPER (5 CYCLES X 1/10")