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Courses » Integral Equations,calculus of variations and its applications

Announcements **Course** Ask a Question Progress Mentor FAQ

Unit 5 - Week 4

Course outline

How to access the portal

Week-1

Week 2

Week 3

Week 4

- Green's function for self adjoint linear differential equations
- Green's function for non-homogeneous boundary value problem
- Fredholm alternative theorem-I
- Fredholm alternative theorem-II
- Fredholm method of solutions
- Quiz : Assignment 4
- Solution of Assignment 4

Assignment 4

The due date for submitting this assignment has passed.

As per our records you have not submitted this assignment. **Due on 2018-09-05, 23:59 IST.**

1) A Green function for the BVP 1 point

$$\frac{d}{dx} \left((1-x^2) \frac{dy}{dx} \right) = 0, \quad y(0) = 0, \quad y(1) \text{ is finite, is given by}$$

$$G(x, \xi) = \begin{cases} \frac{1}{2} \ln \frac{1-x}{1+x}, & 0 \leq x \leq \xi; \\ \frac{1}{2} \ln \frac{1-\xi}{1+\xi}, & \xi \leq x \leq 1. \end{cases}$$

$$G(x, \xi) = \begin{cases} x \ln \frac{1-\xi}{1+\xi}, & 0 \leq x \leq \xi; \\ (x-1) \ln \frac{1-\xi}{1+\xi}, & \xi \leq x \leq 1. \end{cases}$$

$$G(x, \xi) = \begin{cases} \ln \frac{1+x}{1-x}, & 0 \leq x \leq \xi; \\ \ln \frac{1+\xi}{1-\xi}, & \xi \leq x \leq 1. \end{cases}$$

None of these.

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$G(x, \xi) = \begin{cases} \frac{1}{2} \ln \frac{1-x}{1+x}, & 0 \leq x \leq \xi; \\ \frac{1}{2} \ln \frac{1-\xi}{1+\xi}, & \xi \leq x \leq 1. \end{cases}$$

2) Consider the following IVP $y'(x) = f(x), \quad x \geq 0, \quad y(0) = 0.$ 1 point

Then Green function $G(\xi, x)$ for this IVP

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Week 8

Week 9

Week 10

Week 11

Week 12

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is $H(\xi - x) + 2$.

No, the answer is incorrect.

Score: 0

Accepted Answers:

exists but not continuous

3) A Green function for the BVP

1 point

$xy'' + y' = 0$, $y(l) = 0$, $y(0)$ is bounded,
is given by

$$G(x, \xi) = \begin{cases} x \ln \frac{\xi}{l}, & 0 \leq x \leq \xi; \\ \xi \ln \frac{x}{l}, & \xi \leq x \leq l. \end{cases}$$

$$G(x, \xi) = \begin{cases} x \ln \xi l, & 0 \leq x \leq \xi; \\ \xi \ln xl, & \xi \leq x \leq l. \end{cases}$$

$$G(x, \xi) = \begin{cases} \ln \frac{\xi}{l}, & 0 \leq x \leq \xi; \\ \ln \frac{x}{l}, & \xi \leq x \leq l. \end{cases}$$

$$G(x, \xi) = \begin{cases} \frac{1}{2} \ln \xi l, & 0 \leq x \leq \xi; \\ \frac{1}{2} \ln xl, & \xi \leq x \leq l. \end{cases}$$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$G(x, \xi) = \begin{cases} \ln \frac{\xi}{l}, & 0 \leq x \leq \xi; \\ \ln \frac{x}{l}, & \xi \leq x \leq l. \end{cases}$$

4) A Green function for the BVP

1 point

$y^{iv} = 0$, $y(0) = y'(0) = y''(1) = y'''(1) = 0$ is given by

$$G(x, \xi) = \begin{cases} x^2(3\xi - x), & 0 \leq x \leq \xi; \\ \xi^2(3x - \xi), & \xi \leq x \leq 1. \end{cases}$$

$$G(x, \xi) = \begin{cases} x(3\xi - x)^2, & 0 \leq x \leq \xi; \\ \xi(3x - \xi)^2, & \xi \leq x \leq 1. \end{cases}$$

$$G(x, \xi) = \begin{cases} \frac{x^2}{6}(3\xi - x), & 0 \leq x \leq \xi; \\ \frac{\xi^2}{6}(3x - \xi), & \xi \leq x \leq 1. \end{cases}$$

None of these

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$G(x, \xi) = \begin{cases} \frac{x^2}{6}(3\xi - x), & 0 \leq x \leq \xi; \\ \frac{\xi^2}{6}(3x - \xi), & \xi \leq x \leq 1. \end{cases}$$

5) Using Green function the solution of the BVP

0 points

$y^{iv} = 1$, $y(0) = y'(0) = y''(1) = y'''(1) = 0$ is given by



$$y(x) = \frac{x^2}{24} (x^2 - 4x - 6)$$



$$y(x) = x^2 \left(\frac{x^2}{24} - 4x + 6 \right)$$



$$y(x) = \frac{x^2}{24} (x^2 + 2x - 6)$$



$$y(x) = x^2 \left(\frac{x^2}{24} + 4x - 6 \right).$$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$y(x) = \frac{x^2}{24} (x^2 - 4x - 6)$$

6)

1 point

The integral equation corresponding to the BVP $xy'' + y' = x + \lambda y$, $y(1) = y(e) = 0$ is given by $y(x) = f(x) + \lambda \int_1^e G(x, \xi)y(\xi)d\xi$, where $f(x)$ is given by



$$f(x) = \frac{1}{4} (e^2 \ln x + x^2 - 1)$$



$$f(x) = \frac{1}{4} [(1 - e^2) \ln x + 1 - x^2]$$



$$f(x) = \frac{1}{4} [(e^2 - 1) \ln x + 1 - x^2]$$



$$f(x) = \frac{1}{4} [(1 - e^2) \ln x + x^2 - 1].$$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$f(x) = \frac{1}{4} [(1 - e^2) \ln x + x^2 - 1].$$

7)

1 point

If the associated integral equation for the BVP $y'' = \lambda y + e^x$, $y(0) = y(1) = 0$ is given by $y(x) = \lambda \int_0^1 G(x, \xi)y(t)dt + f(x)$, then $f(x)$ is given by



$$f(x) = e^x + ex - x - 1$$



$$f(x) = e^x - ex + x - 1$$



$$f(x) = e^x + ex + x + 1$$



$$f(x) = e^x - ex - x - 1$$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$f(x) = e^x - ex + x - 1$$

8) Consider the Fredholm integral equation $y(x) = \lambda \int_0^\pi \cos x \cos ty(t)dt$. **1 point**

The root of $D_3(1)$, the resolvent determinant of size 3×3 is

$$f(x) = \frac{1}{\pi}$$

$$f(x) = \frac{4}{\pi}$$

$$f(x) = \frac{\pi}{2}$$

$$f(x) = \frac{2}{\pi}$$

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$f(x) = \frac{2}{\pi}$$

9)

1 point

Consider the Fredholm integral equation $y(x) = f(x) + \lambda \int_0^{2\pi} (\sin x - \sin t)y(t)dt$.

Using Fredholm alternative, the resolving kernel $\Gamma(x, t; \lambda)$ is given by

$$\frac{(\sin x - \sin t) + \lambda\pi(1 + 2 \sin x \sin t)}{1 + 4\pi^2\lambda^2}$$

$$\frac{(\sin x - \sin t) - \lambda\pi(1 + 2 \cos x \cos t)}{1 + 2\pi^2\lambda^2}$$

$$\frac{(\sin x - \sin t) - \lambda\pi(1 + 2 \sin x \sin t)}{1 + 2\pi^2\lambda^2}$$

None of these.

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\frac{(\sin x - \sin t) - \lambda\pi(1 + 2 \sin x \sin t)}{1 + 2\pi^2\lambda^2}$$

10)

1 point

Consider the Fredholm integral equation $y(x) = f(x) + \lambda \int_{-1}^1 (x + t + 1)y(t)dt$. Using

Fredholm alternative, the resolving kernel $\Gamma(x, t; \lambda)$ is

$$\frac{(x+t+1) - 2\lambda(3xt+1)}{3+6\lambda-4\lambda^2}$$

$$\frac{3(x+t+1) - 2\lambda(3xt+1)}{3-6\lambda+4\lambda^2}$$

$$\frac{3(x+t+1) + 2\lambda(3xt+1)}{3-6\lambda-4\lambda^2}$$


None of these.

No, the answer is incorrect.

Score: 0

Accepted Answers:

$$\frac{3(x+t+1)+2\lambda(3xt+1)}{3-6\lambda-4\lambda^2}$$

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