

I B. Tech II Semester Regular/Supplementary Examinations, April/May - 2018
MATHEMATICS-II (MM)

(Com to CE,EEE,ME,AE,AME,Bio-Tech,Chem E,Metal E,Min E,PCE,PE)

Time: 3 hours

Max. Marks: 70

- Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B**)
 2. Answer **ALL** the question in **Part-A**
 3. Answer any **FOUR** Questions from **Part-B**

PART -A

1. a) Write the iteration formula to find \sqrt{N} using Newton Raphson method. (2M)
- b) Prove that $\mu\delta = \frac{1}{2}[\Delta + \nabla]$ (2M)
- c) Write the formula for RK method of second order. (2M)
- d) Write Simpson's 1/3rd Rule. (2M)
- e) Find the value of a_0 for $f(x) = \begin{cases} 1 & 0 < x < \frac{\pi}{2} \\ -1 & \frac{\pi}{2} < x < \pi \end{cases}$ (2M)
- f) State Linear property in Fourier Transform. (2M)
- g) Write the equation for the PDE $4\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = 3u$ by variable separable method. (2M)

PART -B

2. a) Find the root of the equation $x^3 - 6x - 4 = 0$ using iteration method. (7M)
- b) Find the root of the equation $2x - \log_{10} x = 7$ using False position method. (7M)
3. a) Find the parabola passing through the points (0,1), (1,3) and (3,55) using Lagrange's interpolation formula. (7M)
- b) Area A of circle and diameter d is given for the following values (7M)

d	80	85	90	95	100
A	5026	5674	6362	7088	7854

Calculate the area of circle of diameter 105.



4. a) Evaluate $y(0.1)$ using RK method of fourth order for $\frac{dy}{dx} = y - \frac{2x}{y}$, $y(0) = 1$ (7M)

b) Evaluate $y(0.1)$, $y(0.2)$ using Picard's method for $\frac{dy}{dx} = x + y$, $y(0) = 1$ (7M)

5. a) Find the Fourier series of $f(x) = \begin{cases} 1 + \frac{2x}{\pi} & \text{if } -\pi \leq x < 0 \\ 1 - \frac{2x}{\pi} & \text{if } 0 \leq x < \pi \end{cases}$ (7M)

Hence deduce that $1 + \frac{1}{3^2} + \frac{1}{5^2} + \dots = \frac{\pi^2}{8}$

b) Find the Half range sine series of $f(x) = x^2$ in $[0, 2]$ (7M)

6. a) Using Fourier integral, Show that $\int_0^{\infty} \frac{\cos \lambda x + \lambda \sin \lambda x}{1 + \lambda^2} d\lambda = \begin{cases} 0 & \text{if } x < 0 \\ \pi e^{-x} & \text{if } x > 0 \end{cases}$ (7M)

b) Find the Fourier cosine transform of $\frac{1}{1+x^2}$ and hence deduce Fourier sine transform $\frac{x}{1+x^2}$ (7M)

7. a) Solve the PDE $\frac{\partial u}{\partial x} = 4 \frac{\partial u}{\partial y}$ where $u(0, x) = 8e^{-3y}$ (7M)

b) A tightly stretched string with fixed end points at $x = 0$ and $x = 1$ is initially in a position given by (7M)

$$f(x) = \begin{cases} x & 0 < x < \frac{1}{2} \\ 1-x & \frac{1}{2} < x < 1 \end{cases}$$

If it is released from this position with velocity zero find the displacement $u(x, t)$ at any point of x of the string at any time $t > 0$.



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PART -A

1. a) Find two iterations of $x = \cos x$ using bisection method. (2M)
- b) Prove that $\Delta \log f(x) = \log \left[1 + \frac{\Delta f(x)}{f(x)} \right]$ (2M)
- c) Write Trapezoidal Rule. (2M)
- d) Write the Dirichlet conditions for Fourier series. (2M)
- e) Find the value of a_n for $f(x) = \begin{cases} 1 & 0 < x < \frac{1}{2} \\ -1 & \frac{1}{2} < x < 1 \end{cases}$ (2M)
- f) State modulation property in Fourier transforms. (2M)
- g) Write two dimensional steady state equation. (2M)

PART -B

2. a) Find the root of the equation $x e^x = 2$ using Newton Raphson method. (7M)
- b) Find the root of the equation $3x = 1 + \cos x$ using False position method. (7M)
3. a) Find the Lagrange's polynomial for the following data, hence find $y(15)$. (7M)

x	-5	6	9	11
y	12	13	14	16
- b) Find $y(23)$ for the following data using Gauss Forward interpolation formula. (7M)

x	10	20	30	40	50
y	9.21	17.54	31.82	55.32	92.51
4. a) Evaluate $y(0.1)$ using RK method of fourth order for $\frac{dy}{dx} = y + xe^x$, $y(0) = 1$ (7M)
- b) Evaluate $y(0.1)$ using Taylor's method for $\frac{dy}{dx} = x + y^2$, $y(0) = 1$ (7M)



5. a) Find the Fourier series of $f(x) = \sin ax$ in $-\pi < x < \pi$ (7M)

b) Find the half range sine series of $f(x) = \begin{cases} x & 0 < x < \frac{l}{2} \\ l-x & \frac{l}{2} < x < l \end{cases}$ (7M)

6. a) Using Fourier cosine integral, show that $\frac{\pi}{2} e^{-x} = \int_0^{\infty} \frac{\cos \lambda x}{\lambda^2 + 1} d\lambda$ (7M)

- b) Find the Fourier sine transform of the function $f(x) = x$ in $(0, \infty)$ (7M)

7. a) Solve $4 \frac{\partial z}{\partial x} - \frac{\partial z}{\partial y} = 3z$ and $z(0, y) = e^{-5y}$ (7M)

- b) Find the temperature $u(x, t)$ in a homogenous bar of heat conducting method of length ' l ' whose ends are kept at 0°C and whose initial temperature is $\frac{ax}{l^2}(l-x)$ (7M)



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1. a) Find two iterations of $x e^x = 2$ using False position method. (2M)
- b) Show that $\nabla = 1 - E^{-1}$ (2M)
- c) Evaluate $y(0.1)$ by Euler's method for $\frac{dy}{dx} = \frac{x+y}{y-x}$, $y(0) = 1$. (2M)
- d) Write Simpson's 3/8th Rule. (2M)
- e) Find the value of b_n for $f(x) = \begin{cases} 1 & 0 < x < \frac{\pi}{2} \\ -1 & \frac{\pi}{2} < x < \pi \end{cases}$ (2M)
- f) Write shifting theorem in Fourier transforms. (2M)
- g) Write one dimensional heat equation. (2M)

PART -B

2. a) Find the root of the equation $x^4 - 10 = x$ using Bisection method. (7M)
- b) Find the root of the equation $x \tan x + 1 = 0$ using Newton Raphson method. (7M)
3. a) Find the Lagrange's polynomial for the following data. (7M)

x	0	2	3	6
y	648	704	729	792

- b) Fit a $y(0.5)$ the following data using Newton Forward interpolation formula. (7M)

x	-1	0	1	2
y	10	5	8	10

4. a) Evaluate $\int_0^2 \frac{1}{1+x} dx$ by taking $h = 0.1$ by (7M)
 - (i) Trapezoidal rule.
 - (ii) Simpson's 1/3rd rule
- b) Evaluate $y(0.1)$ using Modified Euler's method for $\frac{dy}{dx} = x^2 + y^2$, $y(0) = 1$ (7M)



5. a) Find the Half range cosine of $f(x) = \begin{cases} kx & 0 < x < \frac{\pi}{2} \\ k(\pi - x) & \frac{\pi}{2} < x < \pi \end{cases}$ (7M)

b) Find the Fourier series of $f(x) = \frac{\pi - x}{2}$ in $0 < x < 2$ (7M)

6. a) Express the $f(x)$ defined by $f(x) = \begin{cases} 1 & \text{if } |x| < 1 \\ 0 & \text{if } |x| > 1 \end{cases}$ as a Fourier integral (7M)

Hence Evaluate $\int_0^{\infty} \frac{\sin \lambda \cos \lambda x}{\lambda} d\lambda$

b) Find Fourier transform of $f(x) = e^{-x^2}$, $-\infty < x < \infty$ hence evaluate (7M)

(i) $F\left(e^{-\frac{x^2}{3}}\right)$ (ii) $F\left(e^{-4(x-3)^2}\right)$

7. a) Solve $4\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = 3u$ given that $u(0, y) = 3e^{-y} - e^{-5y}$ (7M)

b) A rectangular plate with insulated surface is 8 cm wide. If the temperature along one short edge $y = 8$ cm. is given by $100\sin\frac{\pi x}{8}$, $0 < x < 8$ while the two long edges $x = 0$ and $x = 8$ and other edge are kept 0°C . Find the steady state temperature at any point on the plane (7M)



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PART -A

1. a) Find two iterations of $x = \sin x$ using iteration method. (2M)
- b) Find $\Delta \left(\tan^{-1} \left(\frac{n-1}{n} \right) \right)$ by taking $h=1$ (2M)
- c) Evaluate $y(0.1)$ by Euler's method for $\frac{dy}{dx} = x + y$, $y(0) = 1$. (2M)
- d) Write half range sine series for $f(x) = 1$ in $[0,2]$ (2M)
- e) Find the value of a_n for $f(x) = \begin{cases} 1 & 0 < x < \frac{1}{2} \\ -1 & \frac{1}{2} < x < 1 \end{cases}$ (2M)
- f) Write Finite Fourier cosine transform for $f(x)$ (2M)
- g) Write one dimensional wave equation. (2M)

PART -B

2. a) Find the root of the equation $x^3 - 8x - 4 = 0$ using Newton Raphson method. (7M)
- b) Find the root of the equation $4\sin x = e^x$ using False position method. (7M)
3. a) Find $y(10)$ for the data (7M)
 $y(3)=2.7, y(4)=6.4, y(5)=12.5, y(6)=21.6, y(7)=34.3, y(8)=51.2, y(9) = 72.9$
- b) Evaluate $y(2)$ from the following table. (7M)

X	1	3	5	6	8
Y	2	1.5	2.4	4	5.6

4. a) Evaluate $\int_0^1 \sqrt{1+x^4} dx$ by taking $h = 0.125$ by (7M)
 (i) Simpson's $1/3^{\text{rd}}$ rule (ii) Simpson's $3/8^{\text{th}}$ rule
- b) Evaluate $y(0.1)$ using Taylor's for $\frac{dy}{dx} = x^2 - y^2$, $y(0) = 1$ (7M)

5. a) Find the Fourier series for $f(x) = \begin{cases} -\pi, & -\pi < x < 0 \\ x, & 0 < x < \pi \\ \frac{-\pi}{2}, & x = 0 \end{cases}$ (7M)

Hence deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \dots = \frac{\pi^2}{8}$

b) Find the Half range cosine series of $f(x) = e^x$ in $[0,1]$ (7M)

6. a) Using Fourier integral, Show that $\int_0^{\infty} \frac{\sin \pi \lambda}{1 - \lambda^2} \sin \lambda x d\lambda = \begin{cases} \frac{1}{2} \pi \sin x & \text{if } 0 < x < \pi \\ 0 & \text{if } x > \pi \end{cases}$ (7M)

b) Find the Fourier cosine transform of x^{n-1} (7M)

7. a) Solve $\frac{\partial u}{\partial x} = 2 \frac{\partial u}{\partial t} + u$, where $u(x,0) = 6e^{-3x}$ by the method of separation of variables. (7M)

b) A bar of 50cm long with insulated sides kept at 0° C and that the other end is kept at 100° C until steady state conditions prevail. The two ends are suddenly insulated so that the temperature is zero at each end thereafter. Find the temperature distribution. (7M)



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PART -A

1. a) Define algebraic equation with one example. (2M)
- b) Write a formula for the half range cosine series of $f(x)$ in $[0,L]$. (2M)
- c) Write the change of scale property of Fourier Transform. (2M)
- d) Prove that $\frac{\Delta}{\nabla} - \frac{\nabla}{\Delta} = [\Delta + \nabla]$ (2M)
- e) Find $y(1.2)$ given that by Euler's method $\frac{dy}{dx} = x + y$, $y(1) = 1$ by Euler's method. (2M)
- f) Write a formula for Simpson's $3/8^{\text{th}}$ Rule. (2M)
- g) Write one dimensional wave equation. (2M)

PART -B

2. a) Find the Real root of $e^x \sin x = 2$ using False position method. (7M)
- b) Find the Real root of $x^3 - x - 1 = 0$ using Iteration method. (7M)
3. a) Find the Lagrange's polynomial for the following data. (7M)

x	0	1	2	4
y	2	3	12	14

- b) Find $y(0.5)$ from the following data. (7M)

x	-1	0	1	2
y	10	5	8	10

4. a) Find the Fourier series of $f(x) = \begin{cases} x + \pi & -\pi < x < 0 \\ -x - \pi & 0 < x < \pi \end{cases}$ (7M)

- b) Find the Half range sine series of $f(x) = \begin{cases} \frac{1}{4} - x & 0 < x < \frac{1}{2} \\ x - \frac{3}{4} & \frac{1}{2} < x < 1 \end{cases}$ (7M)

5. a) Find the Finite Fourier sine transform of $f(x)$ defined by (7M)

$$f(x) = \begin{cases} x & 0 < x < \frac{\pi}{2} \\ \pi - x & \frac{\pi}{2} < x < \pi \end{cases}$$



b) Find the Fourier transform of $f(x)$ defined by $f(x) = \begin{cases} x & \text{if } 0 < x < 1 \\ 1-x & \text{if } 1 < x < 2 \\ 0 & \text{if } x > 2 \end{cases}$ (7M)

6. a) Solve the PDE $3\frac{\partial u}{\partial x} + 2\frac{\partial u}{\partial y} = 0$ and $u(x, y) = 4e^{-x}$ (7M)

b) Solve the wave equation $\frac{\partial^2 y}{\partial x^2} = c^2 \frac{\partial^2 y}{\partial t^2}$ (7M)

Subject to

(i) $y(0, t) = 0$

(ii) $y(\pi, t) = 0$

(iii) $y(x, 0) = x, 0 \leq x \leq \pi$

(iv) $\frac{\partial y}{\partial t}(x, 0) = 0, 0 \leq x \leq \pi$

7. a) Evaluate $\int_0^{\pi} \sin x dx$ using (i) Trapezoidal Rule (ii) Simpson's 1/3rd rule. (7M)

b) Using RK method of second order find $y(0.1)$, $y(0.2)$ given that (7M)
 $\frac{dy}{dx} = 2y + e^x, y(0) = 0$



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PART -A

1. a) Find the interval of the existence of the root of the equation $\tan x = x$. (2M)
- b) Write a formula for the half range sine series of $f(x)$ in $[0, \pi]$. (2M)
- c) Write the shifting theorem in Fourier Transform. (2M)
- d) Prove that $\nabla = 1 - E^{-1}$ (2M)
- e) Find $y(1.1)$ given that by Euler's method $\frac{dy}{dx} = xy$, $y(1) = 1$ (2M)
- f) Write a formula for Simpson's 1/3rd Rule. (2M)
- g) Write Laplace equation. (2M)

PART -B

2. a) Find the Real root of $e^x \sin x = 1$ using Bisection method. (7M)
- b) Evaluate $1/\sqrt{12}$ using Newton Raphson method. (7M)
3. a) Find $f(1.75)$ if $f(1.7) = 5.474$, $f(1.8) = 6.050$, $f(1.9) = 6.686$, $f(2) = 7.389$. (7M)
- b) Evaluate $y(4)$ from the following table. (7M)

X	1	3	5	6	8
Y	2	1.5	2.4	4	5.6

4. a) Find the Fourier series of $f(x) = |\sin x|$ in $(-\pi, \pi)$ (7M)

- b) Find the Half range cosine series of $f(x) = \begin{cases} \frac{1}{4} - x & 0 < x < \frac{1}{2} \\ x - \frac{3}{4} & \frac{1}{2} < x < 1 \end{cases}$ (7M)

5. a) Find the Finite Fourier Cosine transform of $f(x)$ defined by (7M)

$$f(x) = \begin{cases} x & 0 < x < 1 \\ 1-x & 1 < x < 2 \end{cases}$$

- b) Find the Fourier transform of $f(x)$ defined by $f(x) = \begin{cases} \frac{\sqrt{2\pi}}{2a} & \text{if } |x| < a \\ 0 & \text{if } |x| > a \end{cases}$ (7M)



6. a) Solve $4\frac{\partial\mu}{\partial x} + \frac{\partial\mu}{\partial y} = 3\mu$ and $u(0, y) = e^{-5y}$ (7M)
- b) A Homogenous rod of conducting material of length 50 cm has its ends kept at zero temperature and the temperature initially is $u(x, 0) = x$ if $0 < x < 50$ (7M)
7. a) Evaluate $\int_{0.6}^2 \frac{1}{1+x} dx$ using (i) Trapezoidal Rule (ii) Simpson's 3/8th rule. (7M)
- b) Using Taylors series method find $y(0.1)$, $y(0.2)$ given that $\frac{dy}{dx} = 2y + 3e^x$, $y(0) = 1$ (7M)



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PART -A

1. a) Write two approximations of $\cos x = x$ using iteration method. (2M)
- b) Find Co-efficient of fourier series a_n for $f(x) = e^{2x}$ in $[0, \pi]$. (2M)
- c) Find the Fourier sine Transform $f(x) = e^{-x}$ in $(0, \infty)$. (2M)
- d) Find $\Delta(f(x)g(x))$ (2M)
- e) Find $y(0.2)$ given that by Euler's method $\frac{dy}{dx} = \frac{x+y}{2}$, $y(0) = 1$ by Euler's method. (2M)
- f) Evaluate $\int_0^1 \frac{dx}{1+x}$ using Trapezoidal Rule. (2M)
- g) Write one dimensional heat equation. (2M)

PART -B

2. a) Find the Real root of $xe^x = \cos x$ using False position method. (7M)
- b) Find the Real root of $x^3 - x - 2 = 0$ using Bisection method. (7M)
3. a) Find the Lagrange's polynomial for the following data. (7M)

x	1	2	4	5
y	2	3	2	4

(7M)

- b) Find $y(1.5)$ from the following data using Gauss Forward interpolation formula.

x	0	1	2	3
y	10	5	8	10

4. a) Find the Fourier series of $f(x) = \begin{cases} x+1 & -1 < x < 0 \\ -x-1 & 0 < x < 1 \end{cases}$ (7M)

- b) Find the Half range sine series of $f(x) = \begin{cases} \frac{1}{2} - x & 0 < x < \frac{1}{2} \\ x - \frac{2}{3} & \frac{1}{2} < x < 1 \end{cases}$ (7M)



5. a) Find the Finite Fourier cosine transform of $f(x)$ defined by (7M)

$$f(x) = \begin{cases} x & 0 < x < 1 \\ 1-x & 1 < x < 2 \end{cases}$$

- b) Find the Fourier transform of $f(x)$ defined by $f(x) = \begin{cases} x & \text{if } 0 < x < \frac{\pi}{2} \\ \pi - x & \text{if } \frac{\pi}{2} < x < \pi \\ 0 & \text{if } x > \pi \end{cases}$ (7M)

6. a) Solve the PDE $\frac{\partial u}{\partial x} - 2\frac{\partial u}{\partial y} = u$ and $u(x, 0) = 3e^{-5x} + 2e^{-3x}$ (7M)

- b) Find the temperature in a bar of length 2 whose ends are kept at zero with initial temperature is $\sin \frac{\pi x}{2} + 3 \sin \frac{5\pi x}{2}$ (7M)

7. a) Evaluate $\int_1^2 \frac{\sin x}{x} dx$ using (i) Trapezoidal Rule (ii) Simpson's 1/3rd rule. (7M)

- b) Using RK method of Fourth order find $y(0.1)$, $y(0.2)$ given that $\frac{dy}{dx} = x^2 - y$, $y(0) = 1$ (7M)



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PART -A

1. a) Find the two approximations of equation $\tan x = x$ bisection method. (2M)
- b) Write the half range sine series of $f(x) = 1$ in $[0, \pi]$ (2M)
- c) Write the Modulation theorem in Fourier Transform. (2M)
- d) Find $\Delta \left(\frac{f(x)}{g(x)} \right)$ (2M)
- e) Find $y(1.5)$ given that by Euler's method $\frac{dy}{dx} = x + y^2$, $y(0) = 1$ (2M)
- f) Find $\int_0^1 \frac{dx}{1+x^2}$ using Trapezoidal Rule. (2M)
- g) Write one possible solution of Wave equation. (2M)

PART -B

2. a) Find the Real root of $e^x - 3x = 0$ using False position method. (7M)
- b) Evaluate $x + \log x_{10} - 2 = 0$ using Newton Raphson method. (7M)
3. a) Find $f(1.85)$ if $f(1.7) = 5.474$, $f(1.8) = 6.050$, $f(1.9) = 6.686$, $f(2) = 7.389$ using Gauss Backward interpolation formula. (7M)
- b) Evaluate $y(x)$ from the following table. (7M)

x	0	1	3	4
y	-12	0	12	24

4. a) Find the Fourier series of $f(x) = |x|$ in $(-\pi, \pi)$ (7M)
- b) Find the Half range cosine series of $f(x) = \begin{cases} x & 0 < x < \frac{1}{2} \\ -x & \frac{1}{2} < x < 1 \end{cases}$ (7M)
5. a) Find the Finite Fourier Cosine transform of $f(x)$ defined by (7M)

$$f(x) = \begin{cases} x & 0 < x < \frac{1}{2} \\ \frac{1}{2} - x & \frac{1}{2} < x < 1 \end{cases}$$



- b) Find the Fourier transform of $f(x)$ defined by $f(x) = \begin{cases} 1-x^2 & \text{if } |x| < 1 \\ 0 & \text{if } |x| > 1 \end{cases}$ (7M)
6. a) Solve $4\frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = 3u$ given that $u(0, y) = 3e^{-y} - e^{-5y}$ (7M)
- b) A rod of 100cm long with insulated sides kept temperature at 0°C and 100°C until steady state prevail two ends are suddenly insulated and kept so. Find the temperature distribution in the rod. (7M)
7. a) Evaluate $\int_0^{\pi} \frac{2}{1+x} dx$ using (i) Trapezoidal Rule (ii) Simpson's 3/8th rule. (7M)
- b) Using Picard's method find $y(0.1)$, $y(0.2)$ given that $\frac{dx}{dy} = 2x - y$, $y(0) = 3$. (7M)



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- Note: 1. Question paper consists of two parts (**Part-A** and **Part-B**)
 2. Answering question in **Part-A** is Compulsory
 3. Answer any **FOUR** Questions from **Part-B**

PART -A

1. a) Find the interval of the existence of root of $\log x - \cos x = 0$. (2M)
- b) Find the relation between E and δ . (2M)
- c) Write formula for Simpson's $3/8^{\text{th}}$ rule. (2M)
- d) Write Dirichlet conditions on Fourier series. (2M)
- e) Write the shifting theorem in Fourier transforms. (2M)
- f) Write the linear solution of heat (one dimensional) equations. (2M)
- g) Write the procedure to solve ODE using Euler's method. (2M)

PART -B

2. a) Find the Real root of the equation $x^3 + 2x^2 + 10x - 20 = 0$ using Newton Raphson method. (7M)
- b) Find the Real root of the equation $xe^x = \cos x$ using Bisection method. (7M)
3. a) Find $y(10)$ from the following data. (7M)

x	5	6	9	11
y	12	13	14	16

- b) Find $y(8)$ from the following data. (7M)

x	4	5	6	7
y	4	10	12	20

4. a) Evaluate $\int_0^5 \frac{dx}{4x+5}$ using (i) Simpson's $3/8^{\text{th}}$ rule with $h = 0.5$ (ii) Trapezoidal rule with $h = 0.5$ (7M)
- b) Find $y(1.2)$ given that $y' = \frac{2xy + e^x}{x^2 + xe^x}$, $y(1) = 0$ by RK method of fourth order (7M)
5. a) Find the Fourier series for $f(x) = \begin{cases} -\pi, & -1 < x < 0 \\ \pi, & 0 < x < 1 \end{cases}$ (7M)

- b) Find the Half range cosine series of $f(x) = \begin{cases} x & 0 < x < \frac{\pi}{2} \\ -x & \frac{\pi}{2} < x < \pi \end{cases}$ (7M)
6. a) Find the Fourier sine transform of (a) $e^{-ax} \cos ax$ (b) $e^{-ax} \sin ax$ (7M)
- b) Find the Fourier cosine transform of $f(x) = \begin{cases} x & \text{if } 0 < x < \frac{1}{2} \\ 1-x & \text{if } \frac{1}{2} < x < 1 \\ 0 & \text{if } x > 1 \end{cases}$ (7M)
7. a) Solve $4 \frac{\partial u}{\partial x} + \frac{\partial u}{\partial y} = 3u$ given that $u(0, y) = 3e^{-y} - e^{-5y}$ (7M)
- b) Solve $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0$ subject to (7M)
- (i) $u(0, y) = 0$ for all y
 - (ii) $u(a, y) = 0$ for all y
 - (iii) $u(x, \infty) = 0, 0 \leq x \leq a$
 - (iv) $u(x, 0) = kx, 0 \leq x \leq a$