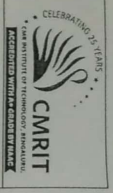


USN



Internal Assessment Test - II

Sub: Engineering Mathematics - III	Sub Code: 17MAT31	Branch: CS, EEE, CV
Date: 15.10.2018	Duration: 90 min's	Marks: 50
Sem/ Sec: III/CS-A, EEE-A, CV-A		OBE

Question 1 is compulsory. Answer any SIX questions from Question 2 to 9.

1.	The following are the marks of 11 students in two papers (out of 100)	MARKS	CO4	RBT																								
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Paper - II	82	56	50	48	60	62	64	65	70	74	90																	

Find the coefficient of correlation and the lines of regression.

2.	Define Karl Pearson's co-efficient of correlation. If θ is the acute angle between the lines of regression, then show that $\tan \theta = \frac{\sigma_{xy}}{\sigma_x^2 + \sigma_y^2} \frac{1-r^2}{r}$. Explain the significance when $r = 0, \pm 1$.	[07]	CO4	L1
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3.	The following table gives the production in thousand units of a certain commodity in different years.	[07]	CO6	L3												
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Fit a straight line to the data and estimate the production in the year 2020.

4.	Find the real root of the equation $xe^x = 2$ lying between 0 and 1 using Regula-Falsi method correct to 3 decimal places. Perform 4 iterations.	[07]	CO6	L3
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5.	Find Z transforms of $\cos n\theta$ and $\sin n\theta$.	[07]	CO2	L3
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6.	Find the inverse Z transform of $\frac{18z^2}{(2z-1)(4z+1)}$.	[07]	CO2	L3
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7.	The area of a circle (A) corresponding to diameter (D) is given below.	[07]	CO6	L3												
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Find the area corresponding to diameter 105 using an appropriate interpolation formula.

8.	Apply Lagrange's method to find the value of x corresponding to $f(x) = 15$ from the following data:	[07]	CO6	L3										
	<table border="1"> <tr> <td>x</td> <td>5</td> <td>6</td> <td>9</td> <td>11</td> </tr> <tr> <td>f(x)</td> <td>12</td> <td>13</td> <td>14</td> <td>16</td> </tr> </table>	x	5	6	9	11	f(x)	12	13	14	16			
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f(x)	12	13	14	16										

9.	Evaluate $\int_2^8 \frac{dx}{\log_{10} x}$, using Simpson's (1/3) rd rule by taking 7 equidistance ordinates.	[07]	CO6	L3
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Signature

Internal Assessment Test - II

Sub:	Engineering Mathematics - III			Sub Code:	17MAT31	Branch:	CS																											
Date:	15.10.2018	Duration:	90 min's	Max Marks:	50	Sem/ Sec:	III/ CS-B.C.																											
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IAT-2

CS - A, B, C
CV - A, EEE - A.

Paper Solution - 17MAT31 - Maths - III

consider $x_i = \text{Marks in Paper I}$, $y_i = \text{Marks in Paper II}$

x_i	y_i	$X_i = x_i - \bar{x}$	$Y_i = y_i - \bar{y}$	$X_i Y_i$	X_i^2	Y_i^2
80	82	15	16	240	225	256
45	56	-20	-10	200	400	100
55	50	-10	-16	160	100	256
56	48	-9	-18	162	81	324
58	60	-7	-6	42	49	36
60	62	-5	-4	20	25	16
65	64	0	-2	00	00	4
68	65	3	-1	-3	9	1
70	70	5	4	20	25	16
75	74	10	8	80	100	64
85	90	20	24	480	400	576

Regression lines:-

① Regression line of x on y .

$$(x - \bar{x}) = r \frac{\sigma_x}{\sigma_y} (y - \bar{y})$$

$$(x - 65) = (0.92) \frac{11.33}{12.24} (y - 66)$$

$$x - 65 = (0.8516) (y - 66)$$

$$\therefore \boxed{x = 0.8516y + 8.4982} \quad \text{--- ①}$$

② Regression line of y on x .

$$(y - \bar{y}) = r \frac{\sigma_y}{\sigma_x} (x - \bar{x})$$

$$(y - 66) = (0.92) \left(\frac{12.24}{11.33} \right) (x - 65)$$

$$(y - 66) = (0.9938) (x - 65)$$

$$\therefore \boxed{y = 0.9938x + 1.403} \quad \text{--- ①}$$

Q.2

To find co-relation between two parameters x and y , Karl Pearson's co-efficient r_2 is defined as.

$$r_2 = \frac{\sum (x_i - \bar{x})(y_i - \bar{y})}{n \sigma_x \sigma_y}$$

where \bar{x} , \bar{y} are the mean of x and y respectively.

σ_x , σ_y are standard deviation of x and y respectively.

n : number of parameters.

- value of r_2 lies between -1 to 1 .
- If $r_2 = 0$, there is no - correlation b/w x and y .
- If $r_2 = \pm 1$, there is perfect co-relation b/w x and y .

(4)

→ Regression line of x on y

$$(x - \bar{x}) = r \frac{\sigma_x}{\sigma_y} (y - \bar{y})$$

$$\therefore (y - \bar{y}) = \frac{1}{r} \frac{\sigma_y}{\sigma_x} (x - \bar{x}) \quad \text{--- (1) --- (1)}$$

Slope of the regression line

$$m_1 = \frac{1}{r} \frac{\sigma_y}{\sigma_x} \quad \text{--- } 0.5$$

→ Regression line of y on x ,

$$(y - \bar{y}) = r \frac{\sigma_y}{\sigma_x} (x - \bar{x}) \quad \text{--- (2) --- (1)}$$

$$\therefore \text{slope } m_2 = r \frac{\sigma_y}{\sigma_x} \quad \text{--- } 0.5$$

If θ is the angle b/w two regression lines,

$$\text{then } \tan \theta = \frac{m_1 - m_2}{1 + m_1 m_2} \quad \text{--- (1)}$$

$$\text{(2) } \left\{ \begin{aligned} &= \frac{\frac{1}{r} \frac{\sigma_y}{\sigma_x} - r \frac{\sigma_y}{\sigma_x}}{1 + \frac{\sigma_y}{\sigma_x} \frac{\sigma_y}{\sigma_x}} = \frac{\left(\frac{1-r^2}{r}\right) \frac{\sigma_y}{\sigma_x}}{\left(\frac{\sigma_x^2 + \sigma_y^2}{\sigma_x^2}\right)} \\ &= \left(\frac{1-r^2}{r}\right) \left(\frac{\sigma_x \sigma_y}{\sigma_x^2 + \sigma_y^2}\right) \end{aligned} \right.$$

Q.3

~~Let~~ take $X = x - 1995$

$X = x - 1995$	y	x_i^2	$x_i y_i$
-20	8	400	-160
-10	10	100	-100
0	12	0	0
10	10	100	100
<u>20</u>	<u>16</u>	<u>400</u>	<u>320</u>
0	56	1000	160

(2)

Normal eqⁿ of the straight line

$$y = ax + b$$

$$\sum y = a \sum x + nb \quad \text{--- (1)}$$

$$\sum xy = a \sum x^2 + b \sum x \quad \text{--- (1)}$$

$$\begin{aligned} \therefore 56 &= a(0) + 5b \Rightarrow b = 11.2 \\ 160 &= a(1000) + b(0) \Rightarrow a = 0.16 \end{aligned} \quad \left. \vphantom{\begin{aligned} \therefore 56 &= a(0) + 5b \\ 160 &= a(1000) + b(0) \end{aligned}} \right\} \text{(1)}$$

$$\therefore y = ax + b$$

$$y = (0.16)(x - 1995) + 11.2$$

$$y = 0.16x - 319.2 + 11.2$$

$$\therefore \boxed{y = 0.16x - 308} \quad \text{--- (1)}$$

$$\therefore \text{production in } x=2020, \boxed{y = 15.2} \quad \text{--- (1)}$$

4. $x e^x - 2 = 0$
 $f(x) = x e^x - 2$

$f(0) = -2 < 0$ $f(1) = 0.7183 > 0$

(11)

I iteration $x_1 = \frac{a f(b) - b f(a)}{f(b) - f(a)}$

$[0, 1]$ $a = 0$ $b = 1$

$x_1 = \frac{0 f(1) - 1 f(0)}{f(1) - f(0)}$

$= \frac{-1(-2)}{0.7183 - (-2)} = 0.73575$

$f(x_1) = f(0.73575) = 0.73575 e^{0.73575} - 2$
 $= -0.46445 < 0$

II iteration $f(0.73575) < 0$

$f(1) > 0$

$[0.73575, 1]$

$x_2 = ?$

$$x_2 = \frac{0.73575 f(1) - 1 f(0.73575)}{f(1) - f(0.73575)} \quad (7)$$

$$= 0.8395$$

$$f(0.8395) = 0.8395 e^{0.8395} - 2 = -0.05638 < 0$$

III iteration $f(0.8395) < 0$ $f(1) > 0$
 $[0.8395, 1]$

$$x_3 = ?$$

$$x_3 = \frac{0.8395 f(1) - 1 f(0.8395)}{f(1) - f(0.8395)}$$

$$x_3 = 0.8512$$

$$f(0.8512) = 0.8512 e^{0.8512} - 2 = -0.0061 < 0$$

IV iteration $f(0.8512) < 0$ $f(1) > 0$
 $[0.8512, 1]$

$$x_4 = \frac{0.8512 f(1) - 1 f(0.8512)}{f(1) - f(0.8512)}$$

$$= 0.8545$$

Ans 0.8545

(11)

(11)

5 Find Z transforms of $\cos n\theta$ and $\sin n\theta$

$$\cos n\theta = \frac{e^{in\theta} + e^{-in\theta}}{2}$$

$$Z(\cos n\theta) = \frac{1}{2} Z(e^{in\theta} + e^{-in\theta})$$

$$= \frac{1}{2} Z(e^{i\theta})^n + \frac{1}{2} Z(e^{-i\theta})^n$$

$$= \frac{1}{2} \left[\frac{z}{z - e^{i\theta}} + \frac{z}{z - e^{-i\theta}} \right]$$

$$= \frac{1}{2} \left[\frac{z(z - e^{-i\theta}) + z(z - e^{i\theta})}{z^2 - z(e^{i\theta} + e^{-i\theta}) + e^{i\theta}e^{-i\theta}} \right]$$

$$= \frac{1}{2} \left[\frac{2z^2 - z(e^{i\theta} + e^{-i\theta})}{z^2 - 2z\cos\theta + 1} \right]$$

$$= \frac{1}{2} \left(\frac{2z^2 - 2z\cos\theta}{z^2 - 2z\cos\theta + 1} \right)$$

$$= \frac{z(z - \cos\theta)}{z^2 - 2z\cos\theta + 1}$$

3M

$$\sin n\theta = \frac{e^{in\theta} - e^{-in\theta}}{2i}$$

$$Z(\sin n\theta) = \frac{1}{2i} \left\{ Z(e^{in\theta}) - Z(e^{-in\theta}) \right\}$$

$$\begin{aligned}
Z(\sin n\theta) &= \frac{1}{2i} \left[\frac{z}{z-e^{i\theta}} - \frac{z}{z-e^{-i\theta}} \right] \\
&= \frac{z}{2i} \left[\frac{1}{z-e^{i\theta}} - \frac{1}{z-e^{-i\theta}} \right] \\
&= \frac{z}{2i} \left[\frac{(z-e^{-i\theta}) - (z-e^{i\theta})}{z^2 - z(e^{i\theta}+e^{-i\theta}) + e^{i\theta}e^{-i\theta}} \right] \\
&= \frac{z}{2i} \frac{(e^{i\theta} - e^{-i\theta})}{z^2 - 2z\cos\theta + 1} \\
&= \frac{z}{2i} \frac{2i\sin\theta}{z^2 - 2z\cos\theta + 1} = \frac{z\sin\theta}{z^2 - 2z\cos\theta + 1}
\end{aligned}$$

(3M)

6. $\bar{w}(z) = \frac{18z^2}{(2z-1)(z+1)}$

$$\begin{aligned}
\frac{\bar{w}(z)}{z} &= \frac{18z}{(2z-1)(z+1)} && (1M) \\
&= 18 \left\{ \frac{z}{(2z-1)(z+1)} \right\} \\
&= 18 \left\{ \frac{A}{2z-1} + \frac{B}{z+1} \right\} \\
&= 18 \left\{ \frac{A(z+1) + B(2z-1)}{(2z-1)(z+1)} \right\}
\end{aligned}$$

$$18z = 18 \left[A(4z+1) + B(2z-1) \right]^2 \quad (10)$$

$$4A + 2B = 1 \quad (1)$$

$$A - B = 0 \Rightarrow A = B \quad (2)$$

$$(1) \text{ \& } 6B = 1 \quad \boxed{B = \frac{1}{6}} \Rightarrow \boxed{A = \frac{1}{6}} \quad (3M)$$

$$\frac{\bar{u}(z)}{z} = -\frac{1}{6} \frac{1}{2z-1} + \frac{1}{6} \frac{1}{4z+1}$$

$$\bar{u}(z) = -\frac{1}{6} \left(\frac{z}{2z-1} \right) + \frac{1}{6} \frac{z}{4z+1} \quad (1M)$$

$$-\frac{1}{6} \cdot \frac{1}{2} \left(\frac{z}{z-\frac{1}{2}} \right) + \frac{1}{6} \cdot \frac{1}{4} \left(\frac{z}{z+\frac{1}{4}} \right)$$

Taking inverse

$$u_n = -\frac{1}{12} \left(\frac{1}{2} \right)^n + \frac{1}{24} \left(-\frac{1}{4} \right)^n, \quad (1M)$$

7. NGBF

$$n = 5$$

h backward differences

$$y_p = y_n + \frac{p}{1!} \nabla y_n + \frac{p(p+1)}{2!} \nabla^2 y_n$$

$$+ \frac{p(p+1)(p+2)}{3!} \nabla^3 y_n + \frac{p(p+1)(p+2)(p+3)}{4!} \nabla^4 y_n$$

$$\text{at } x_p = x_n + ph$$

$$105 = 100 + p(5)$$

$$5 = 5p \Rightarrow p = 1 \quad (1M)$$

$x = D$	$y = A$	Δ	Δ^2	Δ^3	Δ^4
x_0 80	y_0 5024	Δy_0 648	$\Delta^2 y_0$		
85	y_1 5674	Δy_1 688	40	$\Delta^3 y_0$ -2	
x_1 90	y_2 6362	Δy_2 726	38		$\Delta^4 y_0$
x_2 95	y_3 7088	Δy_3 766	40	2	
x_3 100	y_4 7854	Δy_4			
x_4					

$$f(105) = 7854 + 1(766) + \frac{(1)(1+1)}{2!} (40) + \frac{(1)(1+1)(1+2)}{3!} (2) + \frac{(1)(1+1)(1+2)(1+3)}{4!} (2)$$

$$= 7854 + 766 + 40 + 2 + 2 = 8666$$

Area corresponding to $D=105$ is 8666

9. x - No. of petals
 y - No. of flowers

x	y	$\log_e y$	xy	x^2
5	133	4.8903	24.4515	25
6	55	4.0073	24.0438	36
7	23	3.1355	21.9485	49
8	7	1.9459	15.5672	64
9	2	0.6931	6.2379	81
10	2	0.6931	6.9310	100
45		15.3652	99.1799	355

3M

NE's

$$\sum y = nA + b \sum x$$

$$\sum xy = A \sum x + b \sum x^2$$

$$15.3652 = 6A + 45b$$

$$99.1799 = 45A + 355b$$

$$A = 9.4433 \quad b = -0.9177$$

2M

Solving

$$a = e^{9.4433} \approx 12623.3$$

Curve

$$y = ae^{bx} = 12623.3 e^{-0.9177x}$$

1M

98

x	y	Δ	Δ^2	Δ^3
$10 x_0$	$21 y_0$	$\frac{\Delta y_0}{2}$	$\frac{\Delta^2 y_0}{2}$	$\Delta^3 y_0$
$11 x_1$	$23 y_1$	Δy_1	$\Delta^2 y_1$	0
$12 x_2$	$27 y_2$	6	2	
$13 x_3$	$33 y_3$	Δy_2		

$$y = f(x) = y_0 + \frac{p}{1!} \Delta y_0 + \frac{p(p-1)}{2!} \Delta^2 y_0 + \frac{p(p-1)(p-2)}{3!} \Delta^3 y_0$$

3M

at $x = x_0 + ph$ $x = 10 + p(1)$
 $p = x - 10$

$$f(x) = 21 + \frac{x-10}{1!} (2) + \frac{(x-10)(x-11)}{2} (2) + \frac{(x-10)(x-11)(x-12)}{6} (0)$$

$$= 21 + 2x - 20 + x^2 - 19x + 110$$

$$= x^2 - 17x + 111$$

3M

$$= x^2 - 19x + 111$$

1M

Ans

$$f(12.5) = 29.75$$

$$f'(x) = 2x - 19$$

$$f'(12.5) = 6$$

1M

Q.8

x	x_0 5	x_1 6	x_2 9	x_3 11
$y = f(x)$	12 y_0	13 y_1	14 y_2	16 y_3

here, $y = f(x) = 15$ is given, $x = ?$

Applying Lagrange's inverse interpolation formula,

$$x = \left\{ \frac{(y - y_1)(y - y_2)(y - y_3)}{(y_0 - y_1)(y_0 - y_2)(y_0 - y_3)} \right\} (x_0)$$

$$+ \left\{ \frac{(y - y_0)(y - y_2)(y - y_3)}{(y_1 - y_0)(y_1 - y_2)(y_1 - y_3)} \right\} (x_1)$$

$$+ \left\{ \frac{(y - y_0)(y - y_1)(y - y_3)}{(y_2 - y_0)(y_2 - y_1)(y_2 - y_3)} \right\} (x_2)$$

$$+ \left\{ \frac{(y - y_0)(y - y_1)(y - y_2)}{(y_3 - y_0)(y_3 - y_1)(y_3 - y_2)} \right\} (x_3)$$

3

$$\therefore x = \frac{(15-13)(15-14)(15-16)}{(12-13)(12-14)(12-16)} (5) + \frac{(15-12)(15-14)(15-16)}{(13-12)(13-14)(13-16)} (16)$$

$$+ \frac{(15-12)(15-13)(15-16)}{(14-12)(14-13)(14-16)} (9) + \frac{(15-12)(15-13)(15-14)}{(16-12)(16-13)(16-14)} (11)$$

$$= \frac{10}{8} - \frac{18}{3} + \frac{54}{4} + \frac{66}{24}$$

3

$\therefore \boxed{x = 11.5}$

1

Q.9 $I = \int_2^8 \frac{dx}{\log_{10} x}$

here 7 ordinates are given $\therefore n=6$

$\therefore h = \frac{b-a}{n} = \frac{8-2}{6} = 1$ (1)

x	2	3	4	5	6	7	8
$y = \frac{1}{\log_{10} x}$	3.3219	2.0959	1.6609	1.4306	1.2850	1.1832	1.1073
	y_0	y_1	y_2	y_3	y_4	y_5	y_6

(2)

by Simpson's $(\frac{1}{3})^{\text{rd}}$ rule,

$I = \frac{h}{3} [(y_0 + y_6) + 2(y_2 + y_4) + 4(y_1 + y_3 + y_5)]$ (01)

$= \frac{1}{3} [(3.3219 + 1.1073) + 2(1.6609 + 1.2850) + 4(2.0959 + 1.4306 + 1.1832)]$ (02)

$= \frac{1}{3} [29.1598]$

$I = 9.7199$ (1)