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BMATEC301/BEC/BBM301

Third Semester B.E./B.Tech. Degree Examination, Dec.2023/Jan.2024

**AV Mathematics – III for EC Engineering**

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.

2. Statistical Tables and Mathematics VTU Formula Hand Book is permitted.

3. M : Marks , L: Bloom's level , C: Course outcomes.

Module – 1				M	L	C													
Q.1	a.	Find the Fourier series expansion of the function $f(x) = x^2$ in $(-\pi, \pi)$ and hence deduce that $\frac{\pi^2}{12} = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \dots$		7	L2	CO1													
	b.	Find the Cosine half range series for $f(x) = \begin{cases} x & , 0 < x < \pi/2 \\ \pi - x & , \pi/2 < x < \pi \end{cases}$		6	L2	CO1													
	c.	Obtain the Fourier series upto first harmonics of the following data : <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>x</td> <td>0</td> <td><math>\pi/6</math></td> <td><math>2\pi/6</math></td> <td><math>3\pi/6</math></td> <td><math>4\pi/6</math></td> <td><math>5\pi/6</math></td> </tr> <tr> <td>y</td> <td>0</td> <td>9.2</td> <td>14.4</td> <td>17.8</td> <td>17.3</td> <td>11.7</td> </tr> </table>	x	0	$\pi/6$	$2\pi/6$	$3\pi/6$	$4\pi/6$	$5\pi/6$	y	0	9.2	14.4	17.8	17.3	11.7		7	L3
x	0	$\pi/6$	$2\pi/6$	$3\pi/6$	$4\pi/6$	$5\pi/6$													
y	0	9.2	14.4	17.8	17.3	11.7													
OR																			
Q.2	a.	Obtain the Fourier series for the Triangular waveform $f(x) = \begin{cases} 1 + \frac{2x}{\pi} & , -\pi < x < 0 \\ 1 - \frac{2x}{\pi} & , 0 < x < \pi \end{cases}$		7	L2	CO1													
	b.	Find the sine half – range series for $f(x) = x^2 - x$ in $0 < x < 1$ .		6	L2	CO1													
	c.	Obtain the constant term and the first two coefficients in the Fourier cosine series for y, where y is given in the following table : <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>x</td> <td>0</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> <tr> <td>y</td> <td>4</td> <td>8</td> <td>15</td> <td>7</td> <td>6</td> <td>2</td> </tr> </table>	x	0	1	2	3	4	5	y	4	8	15	7	6	2		7	L3
x	0	1	2	3	4	5													
y	4	8	15	7	6	2													
Module – 2																			
Q.3	a.	Find the Fourier transform of $f(x) = \begin{cases} 1 & ,  x  \leq 1 \\ 0 & ,  x  > 1 \end{cases}$ . Hence Evaluate $\int_0^{\infty} \frac{\sin x}{x} . dx$		7	L3	CO2													
	b.	Find the Fourier Cosine transform of $f(x) = \begin{cases} 4x & , 0 < x < 1 \\ 4 - x & , 1 < x < 4 \\ 0 & , x > 4 \end{cases}$		6	L2	CO2													
	c.	Find Fourier transform of $f(x) = e^{- x }$ .		7	L3	CO2													

OR				
Q.4	a.	Solve the Integral equation $\int_0^{\infty} f(\theta) \cdot \cos \alpha \theta \cdot d\theta = \begin{cases} 1-\alpha & , 0 \leq \alpha \leq 1 \\ 0 & , \alpha > 1 \end{cases}$ . Hence evaluate $\int_0^{\infty} \frac{\sin^2 t}{t^2} \cdot dx$	7	L3 CO2
	b.	Find the Fourier sine transform of $\frac{e^{-ax}}{x}$ , $a > 0$ .	6	L2 CO2
	c.	i) Find the Discrete Fourier transform of the signal $f = [0, 1, 4, 9]^T$ . ii) Find the Inverse Discrete Fourier transform of the signal obtained in part (i).	7	L3 CO2
Module – 3				
Q.5	a.	Obtain the Z – transform of $\cos n \theta$ and $\sin n \theta$ .	7	L2 CO3
	b.	Find the Inverse Z – transform of $\frac{3z^2 + 2z}{(5z-1)(5z+2)}$ .	6	L3 CO3
	c.	If $U(z) = \frac{2z^2 + 3z + 12}{(z-1)^4}$ , then evaluate $u_0, u_1, u_2$ .	7	L3 CO3
OR				
Q.6	a.	Find the Z – transform of $\cos \left( \frac{n\pi}{2} + \frac{\pi}{4} \right)$ .	6	L2 CO3
	b.	Obtain the Inverse Z – transform of $\frac{z^2 - 8z}{(z-4)^2}$ .	7	L3 CO3
	c.	Solve the Difference equation $Y_{n+2} + 6Y_{n+1} + 9Y_n = 2^n$ with the conditions $y_0 = 0$ and $y_1 = 0$ using Z – transform.	7	L3 CO3
Module – 4				
Q.7	a.	Solve $(4D^4 - 8D^3 - 7D^2 + 11D + 6)y = 0$ .	6	L2 CO4
	b.	Solve $\frac{d^2y}{dx^2} + 4y = x^2 + \cos 2x$ .	7	L2 CO4
	c.	Solve $(2x+1)^2 y'' - 6(2x+1)y' + 16y = 8(2x+1)^2$ .	7	L3 CO4
OR				
Q.8	a.	Solve $x^2 y'' - 3xy' + 4y = (1+x)^2$ .	7	L2 CO4
	b.	Solve $y'' + 2y' + y = 2x + x^2$ .	6	L2 CO4
	c.	In an L-C-R circuit, the charge $q$ on a plate of a condenser is given by $L \frac{d^2q}{dt^2} + R \frac{dq}{dt} + \frac{q}{c} = E \sin pt$ . Solve the above equation.	7	L3 CO4

Module – 5																									
Q.9	a.	Ten students got the following percentage of marks in two subjects x and y. Compute their rank correlation co-efficient.	7 L3 CO5																						
		<table border="1"> <tr> <td>Marks in x</td> <td>78</td> <td>36</td> <td>98</td> <td>25</td> <td>75</td> <td>82</td> <td>90</td> <td>62</td> <td>65</td> <td>39</td> </tr> <tr> <td>Marks in y</td> <td>84</td> <td>51</td> <td>91</td> <td>60</td> <td>68</td> <td>62</td> <td>86</td> <td>58</td> <td>53</td> <td>47</td> </tr> </table>	Marks in x	78	36	98	25	75	82	90	62	65	39	Marks in y	84	51	91	60	68	62	86	58	53	47	
	Marks in x	78	36	98	25	75	82	90	62	65	39														
Marks in y	84	51	91	60	68	62	86	58	53	47															
b.	Fit second degree parabola $y = a + bx + cx^2$ in least square sense and hence find y when x = 6.	6 L2 CO5																							
		<table border="1"> <tr> <td>x</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> </tr> <tr> <td>y</td> <td>10</td> <td>12</td> <td>13</td> <td>16</td> <td>19</td> </tr> </table>	x	1	2	3	4	5	y	10	12	13	16	19											
x	1	2	3	4	5																				
y	10	12	13	16	19																				
	c.	The two regression equation of the form variables x and y are $x = 19.13 - 0.87y$ and $y = 11.64 - 0.50x$ . Find i) Mean of x's            ii) Mean of y's iii) The correlation co-efficient between x and y.	7 L2 CO5																						
OR																									
Q.10	a.	Compute the co-efficient of correlation and equation of the lines of regression for the data :	7 L3 CO5																						
		<table border="1"> <tr> <td>x</td> <td>1</td> <td>2</td> <td>3</td> <td>4</td> <td>5</td> <td>6</td> <td>7</td> </tr> <tr> <td>y</td> <td>9</td> <td>8</td> <td>10</td> <td>12</td> <td>11</td> <td>13</td> <td>14</td> </tr> </table>	x	1	2	3	4	5	6	7	y	9	8	10	12	11	13	14							
	x	1	2	3	4	5	6	7																	
y	9	8	10	12	11	13	14																		
b.	Fit the curve $y = ax^b$ for the following data :	6 L2 CO5																							
		<table border="1"> <tr> <td>x</td> <td>0.5</td> <td>1</td> <td>1.5</td> <td>2.0</td> <td>2.5</td> <td>3.0</td> </tr> <tr> <td>y</td> <td>1.62</td> <td>1.00</td> <td>0.75</td> <td>0.62</td> <td>0.52</td> <td>0.46</td> </tr> </table>	x	0.5	1	1.5	2.0	2.5	3.0	y	1.62	1.00	0.75	0.62	0.52	0.46									
x	0.5	1	1.5	2.0	2.5	3.0																			
y	1.62	1.00	0.75	0.62	0.52	0.46																			
	c.	Find the co-efficient of correlation for the following data :	7 L3 CO5																						
		<table border="1"> <tr> <td>x</td> <td>10</td> <td>14</td> <td>18</td> <td>22</td> <td>26</td> <td>30</td> </tr> <tr> <td>y</td> <td>18</td> <td>12</td> <td>24</td> <td>6</td> <td>30</td> <td>36</td> </tr> </table>	x	10	14	18	22	26	30	y	18	12	24	6	30	36									
x	10	14	18	22	26	30																			
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