

STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 86
(For candidates admitted from the academic year 2023 – 2024)

B. Sc. DEGREE EXAMINATION, APRIL 2024
BRANCH III – PHYSICS
SECOND SEMESTER

COURSE : **ALLIED CORE**
PAPER : **MATHEMATICS FOR PHYSICS II**
SUBJECT CODE : **23MT/AC/MP25**
TIME : **3 HOURS**

MAX. MARKS: 100

Q. No.	SECTION A (5 × 2 = 10) Answer ANY FIVE questions	CO	KL
1.	Define Laplace transform.	1	1
2.	Find the Inverse Laplace transform of $\frac{10}{(s+2)^6}$	1	1
3.	Define Beta function.	1	1
4.	State the formula for Newton's forward interpolation.	1	1
5.	Define correlation.	1	1
6.	Compute the probable error assuming the correlation coefficient of 0.9 from a sample of 25 pairs of items.	1	1

Q. No.	SECTION B (10 × 1 = 10) Answer ALL questions	CO	KL
7.	$L\{f'(t)\} = \underline{\hspace{2cm}}$ a) $sf(s) - f(0)$ b) $s\bar{f}(s) - f(0)$ c) $s\bar{f}(s) - \bar{f}(0)$ d) none	2	2
8.	$L\{e^{-at}\} = \underline{\hspace{2cm}}$ a) $\frac{1}{s-a}$ b) $\frac{1}{s+a}$ c) $s + a$ d) none	2	2
9.	$L^{-1}\left[\frac{1}{s^2 + a^2}\right] = \underline{\hspace{2cm}}$ a) $\frac{\sin at}{a}$ b) $\sin at$ c) $\cos at$ d) none	2	2
10.	$L^{-1}\left[\frac{1}{s^{n+1}}\right] = \underline{\hspace{2cm}}$ a) $\frac{t}{n!}$ b) t^n c) $\frac{t^n}{n!}$ d) none	2	2

11.	$\Gamma(1) = \underline{\hspace{2cm}}$ a) 0 b) 1 c) -1 d) none	2	2
12.	$\Gamma(n + 1) = \underline{\hspace{2cm}}$ a) $\Gamma(n)$ b) $n\Gamma(n)$ c) n d) none	2	2
13.	$\Delta^n = \underline{\hspace{2cm}}$ a) $E - 1$ b) $(E - 1)^n$ c) $(E)^n$ d) none	2	2
14.	Lagrange's method of interpolation is applicable when the intervals are $\underline{\hspace{2cm}}$ a) equal b) unequal c) zero d) none	2	2
15.	The coefficient of correlation lies between $\underline{\hspace{2cm}}$ a) 1 b) -1 c) -1 and +1 d) none	2	2
16.	When $r = 0$ the two variables are $\underline{\hspace{2cm}}$ a) Positive correlation b) negative correlation c) Uncorrelated d) none	2	2

Q. No.	SECTION C (2 × 15 = 30) Answer ANY TWO questions	CO	KL
17.	Find the Laplace transform for the following i) $\cos 4t \sin 3t$ ii) $\sin^2 3t$ iii) $t^4 - t^2 - t + \sin \sqrt{2}t$ iv) $e^{-3t} \cos 2t$ (3+4+4+4)	3	3
18.	Solve $y'' - 3y' + 2y = \sin t$, given $y(0) = 0, y'(0) = -1$.	3	3
19.	Prove that $\beta(m, n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$	3	3

20.	The following are the annual premiums for a policy of Rs. 1000. Calculate the premium at the age of 32 using Newton's formula.	3	3												
	<table border="1"> <tr> <td>Age in years</td> <td>20</td> <td>25</td> <td>30</td> <td>35</td> <td>40</td> </tr> <tr> <td>Premium in Rs.</td> <td>24</td> <td>27</td> <td>31</td> <td>36</td> <td>42.5</td> </tr> </table>	Age in years	20	25	30	35	40	Premium in Rs.	24	27	31	36	42.5		
Age in years	20	25	30	35	40										
Premium in Rs.	24	27	31	36	42.5										

Q. No.	SECTION D (2 × 15 = 30) Answer ANY TWO questions	CO	KL																
21.	Find the Laplace transform for the following i) $e^{2t}t^n$ ii) $te^{2t}\cos 5t$ iii) $\frac{e^{3t}-e^{-2t}}{t}$ (3+6+6)	4	4																
22.	Find the inverse Laplace transform for the following i) $\frac{s^2+9s+2}{(s-1)^2(s+2)}$ ii) $\frac{2(s+1)}{(s^2+2s+2)^2}$ (7+8)	4	4																
23.	Prove that i) $\beta(m, n) = \beta(n, m)$ ii) $\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$ (5+10)	4	4																
24.	Calculate the coefficient of correlation between x and y for the following data <table border="1"> <tr> <td>x</td> <td>10</td> <td>12</td> <td>13</td> <td>16</td> <td>17</td> <td>20</td> <td>25</td> </tr> <tr> <td>y</td> <td>19</td> <td>22</td> <td>26</td> <td>27</td> <td>29</td> <td>33</td> <td>37</td> </tr> </table>	x	10	12	13	16	17	20	25	y	19	22	26	27	29	33	37	4	4
x	10	12	13	16	17	20	25												
y	19	22	26	27	29	33	37												

Q. No.	SECTION E (2 × 10 = 20) Answer ANY TWO questions	CO	KL																						
25.	i) Evaluate $\int_0^{\infty} \frac{x^8(1-x^6)}{(1+x)^{24}}$ ii) Evaluate $\int_0^1 x^7(1-x)^8 dx$ (7+3)	5	5																						
26.	Find the inverse Laplace transform for the following i) $\frac{s-3}{s^2+4s+13}$ ii) $\frac{1}{s(s^2+4)}$ (5+5)	5	5																						
27.	The following table gives the normal weight of a baby during the six months of life. <table border="1" data-bbox="336 869 1099 1016"> <tr> <td>Age in months</td> <td>0</td> <td>2</td> <td>3</td> <td>5</td> <td>6</td> </tr> <tr> <td>Weight in lbs</td> <td>5</td> <td>7</td> <td>8</td> <td>10</td> <td>12</td> </tr> </table> Estimate the weight of a baby at the age of 4 months using Lagrange interpolation.	Age in months	0	2	3	5	6	Weight in lbs	5	7	8	10	12	5	5										
Age in months	0	2	3	5	6																				
Weight in lbs	5	7	8	10	12																				
28.	Find the rank correlation coefficient for the following data: <table border="1" data-bbox="336 1205 1114 1352"> <tr> <td>x</td> <td>92</td> <td>89</td> <td>87</td> <td>86</td> <td>86</td> <td>77</td> <td>71</td> <td>63</td> <td>53</td> <td>50</td> </tr> <tr> <td>y</td> <td>86</td> <td>83</td> <td>91</td> <td>77</td> <td>68</td> <td>85</td> <td>52</td> <td>82</td> <td>37</td> <td>57</td> </tr> </table>	x	92	89	87	86	86	77	71	63	53	50	y	86	83	91	77	68	85	52	82	37	57	5	5
x	92	89	87	86	86	77	71	63	53	50															
y	86	83	91	77	68	85	52	82	37	57															
