



**Topic: 4.5 – TAYLOR SERIES FOR FUNCTIONS OF TWO VARIABLES**

③ Expand  $\sin(xy)$  in powers of  $x-1$  and  $y-\frac{\pi}{2}$  upto second degree terms.

Function	Value at $(1, \frac{\pi}{2})$
$f(x,y) = \sin(xy)$	$f = 1$
$f_x = y \cos(xy)$ $f_y = x \cos(xy)$	$f_x = 0$ $f_y = 0$
$f_{xx} = -y^2 \sin(xy)$ $f_{xy} = -xy \sin(xy) + \cos xy$ $f_{yy} = -x^2 \sin(xy)$	$f_{xx} = -\frac{\pi^2}{4}$ $f_{xy} = -\frac{\pi}{2}$ $f_{yy} = -1$

Here  $a = 1$ ,  $b = \frac{\pi}{2}$ ,  $h = x-1$  and  $k = y-\frac{\pi}{2}$

$$f(x,y) = 1 + \left[ (x-1) \cdot 0 + (y-\frac{\pi}{2}) \cdot 0 \right] + \frac{1}{2!} \left[ (x-1)^2 \left(-\frac{\pi^2}{4}\right) + 2(x-1)(y-\frac{\pi}{2}) \left(-\frac{\pi}{2}\right) + (y-\frac{\pi}{2})^2 (-1) \right] + \dots$$
$$= 1 + \frac{1}{2} \left[ -\frac{\pi^2}{4} (x-1)^2 - \pi (x-1)(y-\frac{\pi}{2}) - (y-\frac{\pi}{2})^2 \right] + \dots$$



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④ Find the Taylor's series expansion of  $x^2y^2 + 2xy^2 + 3xy^2$  in powers of  $(x+2)$  and  $(y-1)$  upto third degree terms.

Function	Value at $(-2, 1)$
$f(x, y) = x^2y^2 + 2xy^2 + 3xy^2$	$f = 6$
$f_x = 2xy^2 + 4xy + 3y^2$	$f_x = -9$
$f_y = 2x^2y + 2x^2 + 6xy$	$f_y = 4$
$f_{xx} = 2y^2 + 4y$	$f_{xx} = 6$
$f_{xy} = 4xy + 4x + 6y$	$f_{xy} = -10$
$f_{yy} = 2x^2 + 6x$	$f_{yy} = -4$

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$f_{yy} = 2x^2 + 6x$	$f_{yy} = -4$
$f_{xxx} = 0$	$f_{xxx} = 0$
$f_{xxy} = 4y + 4$	$f_{xxy} = 8$
$f_{xyy} = 4x + 6$	$f_{xyy} = -2$
$f_{yyy} = 0$	$f_{yyy} = 0$

$$f(x, y) = 6 + \frac{1}{1!} [-9(x+2) + 4(y-1)] + \frac{1}{2!} [6(x+2)^2 - 20(x+2)(y-1) - 4(y-1)^2] + \frac{1}{3!} [24(x+2)^2(y-1) - 6(x+2)(y-1)^2] + \dots$$



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