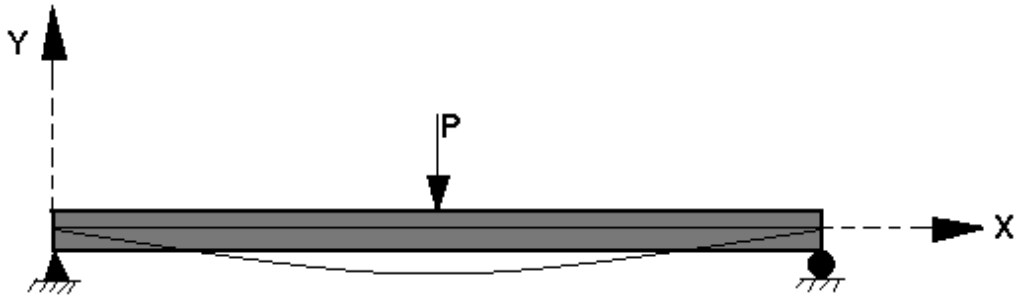
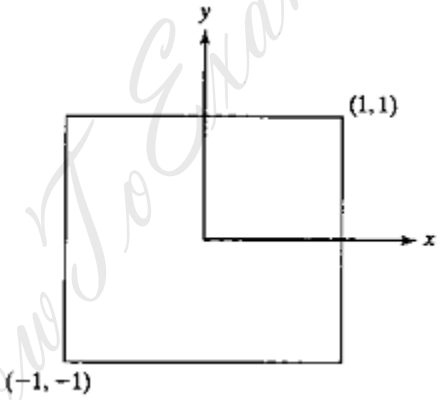
ROLL NO.:	TEST-1	TIME: 45mins
SECTION: M2116	FINITE ELEMENT METHODS (MEC912)	FULL MARKS-20

(1) A simply supported beam of uniform cross section and length L is loaded by a central concentrated load, P. Assume that the beam deflects into the sine wave as shown in fig below, such that $y = A\sin\left(\frac{\pi x}{L}\right)$. This assumed shape is a trial function and A is an undetermined coefficient.



Since the elastic strain energy due to bending is given by: $U = \frac{1}{2}\int EI(d^2y/dx^2)\,dx$. Determine the displacement at the centre of the beam using Rayleigh-Ritz method. The symbols have their usual meaning. [8]

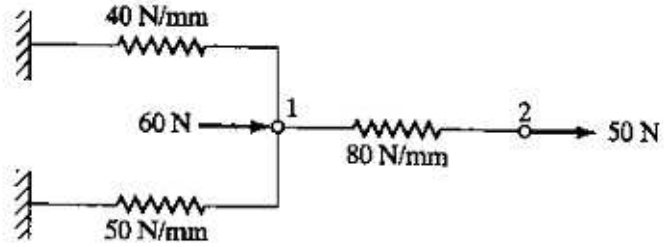
(2) A displacement field: $u = 1 + 3x + 4x^3 + 6xy^2$;
$v = xy - 7x^2$
is imposed on the square element as shown in fig below:



(a) Write down the expressions for: ϵ_x , ϵ_y and γ_{xy}.
(b) Find where ϵ_x is maximum within the square. [4]

(3) A long rod is subjected to loading and a temperature increase of 30°C. The total strain at a point is measured to be 1.2 X 10^{-5}. If E = 200 GPa and α = 12 X 10^{-6}/°C, determine the stress at the point. [4]

(4)Determine the displacements of nodes of the spring system shown in fig below:



[4]