Full Marks – 100   Time Allowed – 3 Hours

Answer any ***Four*** questions.

1. Explain plastic hinge, shape factor, load factor and different types of mechanisms of plastic collapse. Determine the shape factor for a steel I-section made of 175 mm x 25 mm thick top flange plate, 475 mm x 10 mm thick web plate and 125 mm x 25 mm thick bottom flange plate.

2. State and explain Static and Kinematic theorems used in plastic analysis. A beam of length L and fully plastic moment capacity M_p is simply supported at one end and fixed at the other end. The beam is subjected to a uniformly distributed load w per unit length over the entire span. Find the collapse value of load w and show the positions of plastic hinges indicating their chronological development.

3. A continuous beam ABC is simply supported at the three supports A, B and C. AB = 5.0 m and BC = 8.0 m with a central concentrated load of 2W on span AB and an uniformly distributed load of W/4 on the entire span of BC. The beam has a uniform section with fully plastic moment M_p = 400 kNm. Determine the loads at the formation of the first and second plastic hinges in the continuous beam ABC.

4. In a rectangular portal frame ABCD the support A is pinned and the support D is fixed. The columns AB and CD are vertical with heights 4.5m and 5.5m respectively. The beam BC is horizontal with a span of 9.0m.The fully plastic moment capacities of AB, BC and CD are M_p, $3M_p$ and $2M_p$ respectively. A vertical load of 3P acts at mid span of BC and a horizontal load P acts at B towards C. Find the collapse load P and draw the Bending Moment Diagram at collapse.

5. An inclined portal frame PQRS has P hinged and S fixed. Column PQ is vertical with height 4.0m. Beam QR is horizontal with span 8.0m and RS is 5.0m long with an inclination of 60^0 with vertical. A vertical load 2W acts on QR at 5.0m distance from Q and a horizontal load W acts at Q towards R. Determine the collapse load and draw the bending moment diagram at collapse. Assume fully plastic moment capacity M_p all through.

6. Coordinates of the joints of a fixed base doubly inclined portal frame are given in metres as (0, 0), (4, 4), (12, 4) and (17, 1) respectively. A vertical load of P acts on the top beam at 3m distance from the left end of the beam and a horizontal load of P/2 acts from left to right at the top beam level. Find the collapse load and draw the collapse bending moment diagram. Assume M_p as constant.