Question (1) (40 marks)

1) Write short notes with sketches about:
   a) Decrease the effect of My in roof purlins.
   b) Welding Process
   c) Modes of failure of bolted connections.

2) Find the maximum compression and tension forces that can be carried by $2 < 100 \times 100 \times 10$, if the $L_{hx} = 2.0 \text{ m}$ and $L_{hy} = 4.0 \text{ m}$, using bolts M16 grade 5.6, and find the maximum length permitted in each case.

3) Find the maximum capacity ($P$) for the bolted connection shown in Fig. (1) using bolts M16 grade 5.6 and for the welded connection shown in Fig. (2)?

4) A steel structure is to be designed to cover the area (23.0 ms x 60.00 ms) as shown in Fig. (3). The area ABCD is opened while area CDEF is closed. The columns may be arranged only on the lines CDEF. The clear height of the total area is 8.0 ms. Draw to a suitable scale a general layout showing the different elements of the structure and bracing systems (plan, elevations, side views and end gable)?

5) For the roof truss shown in Fig. (4), calculate the buckling lengths for members A, B, C, D and E?

6) Design the bolted connection shown in Fig. (5) using bolts M16 grade 4.6, case A, if the connection with a continuous joint and design the welded connection shown in Fig. (6), if the connection with a separated joint and case B) draw its details to scale 1:10?
**Question (2) (30 marks)**

The steel frame shown in fig. (7) is one of series that form the skeleton of a workshop. The frames are composed of saw tooth steel framed truss with two fixed steel column 10.0 ms high. The truss is divided into 6 panels 2.0 ms each, spaced 5.0 ms apart. The roof covering is a corrugated steel sheet.

**GIVEN DATA:**
- Weight of corrugated steel sheets = 15.0 kg/m²
- Weight of steel structure = 35.0 kg/m²
- Live load and wind load should be taken as Egyptian Code of Practice

**REQUIREMENTS:**
1) Draw the load distributions acting on the truss due to dead load, live load and wind load?
2) Design a suitable section for simply supported purlin [purlin span=5.0m]?
3) Design a suitable rolled section [B.F.I.] for the simply supported crane track girder which subjected to two moving load 8.0 t each and 2.0 ms distance apart, [given the impact coefficient = 25% and the lateral shock = 10% of the maximum live load]?  

**Question (3) (20 marks)**

1) Fig. (8) shown the welded connection between B.F.I. No. (340) and gusset plate t=12 mm subjected to compression force, given the lengths of weld. Find the maximum compression force can be carried by the connection?

2) For the connection shown in fig. (9). Check the given number of bolts, if Reaction of secondary beam = 18.0 ton? [bolts M20 grade 5.8]

3) Check of the number of bolts which connecting the bracket to the column as shown in fig. (10), using M20 grade 4.6 if the load P=20.0 t is carried by plate 1.2 cm thickness, and the column is B.F.I No. (300).?