



THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of Jkuat)

Faculty of Engineering and Technology

DEPARTMENT OF BUILDING AND CIVIL ENGINEERING

**UNIVERSITY EXAMINATIONS FOR BACHELOR OF
SCIENCE IN CIVIL ENGINEERING**

ECE 2407 : STRUCTURAL DESIGN I

END OF SEMESTER EXAMINATION

SERIES: AUGUST/SEPTEMBER 2011

TIME: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Answer booklet*
- *Battery Powered Programmable Calculators may be used*

This paper consists of **FIVE** questions in **TWO** sections **A & B**

Answer question **ONE (COMPULSORY)** and any other **TWO** questions

Maximum marks for each part of a question are as shown

This paper consists of **FOUR** printed pages

SECTION A (COMPULSORY – 30 MARKS)

Question 1

- a) BS 5950 employs four design methods. List **THREE** methods giving a brief description of each (12 marks)
- b) A 200mm x 50mm timber joist in a load sharing system spans an opening of 30m. If the total load (dead plus imposed) is 1.5KN/m, check its adequacy in bending. Assume the grade stress in bending is 4.8N/mm² and the timber weighs 500kg/m³. (8 marks)

- c) The joint shown is subjected to a dead load of 90 KN and a tensile imposed load of 100 KN. All data regarding the member and joint are shown in the figure. The steel grade is 43 (S275) and the bolt grade is 4.6. Check the shear capacity of the joint (10 marks)

SECTION B (Answer any TWO questions from this section. Each question carries 20 marks)

Question 2

It is required to design a timber joisted floor for a dwelling where the joists are spaced at 600mm centres and the floor has an effective span of 2.8m. The flooring is T&G boarding 25mm thick with a finishing of PVC tiles. Limiting the breadth of the joists to 50mm, design the most economical section for the joist. The following information may be used:

Imposed load	1.5KN/m ²
Weight of PVC tiles	0.1KN/m ²
Density of T&G and Joists	500kg/m ³

(Assume the following material properties: grade stresses parallel to grain: bending = 4.8 N/mm², Compression = 6.0N/mm², shear = 1.1N/mm², Tension = 3.0N/mm²: compression perpendicular to grain = 1.6N/mm². E = 740 N/mm²) (20 marks)

Question 3

- a) List the general requirements of the empirical method for the design of Purlins as set out in BS 5950 Part 1 (4 marks)

- b) A simply supported steel beam of span 6.0m is required to carry a uniform dead load of 40 KN/m and an imposed load of 20KN/m. The floor slab system provides full lateral restraint to the beam. If a 457 x 191UB 67 of Grade 43 (S275) steel is available for this purpose, check its adequacy in terms of bending, shear and deflection (16 marks)

Question 4

The figure below shows a typical timber roof truss. The trusses have a span of 8.0m and a spacing of 2.0m centres. Check the adequacy of a 150mm x 50mm rafter given the following information.

Roofing sheets	0.15 KN/m ²
Imposed load	0.25KN/m ²
Ceiling load	0.25KN/m ²
Truss self weight (estimated)	0.89KN
Roof slope	25.0°
Purlins	150mm x 50mm
Purlin spacing	1.0 m (on plan)

(Assume the following properties for the timber used:
 $E = 7400N / mm^2$; $\sigma_{c,gr,||} = 6.0N / mm^2$; $\sigma_{m,gr,||} = 4.8N / mm^2$; $\gamma = 500Kg / m^3$

(20 marks)

Question 5

- a) List **FOUR** ultimate limit states and FOUR serviceability limit states relevant to structural steelwork design according to BS 5950 (4 marks)
- b) A bolted eccentric connection (illustrated below) is subjected to a vertical ultimate load of 120 KN. Determine the size of Grade 4.6 bolts required if the load is placed at an eccentricity of 300 mm. (16 marks)

