ELIZADE UNIVERSITY, ILARA-MOKIN
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
CVE 508 : DESIGN OF STRUCTURE III
EXAMINATION FOR SECOND SEMESTER 2018/2019 SESSION

Instructions: Answer either **question 1or 2** plus either **question 3 or 4** plus **question 5.**
Answer **Three questions** in all, **Question 5 is compulsory,**

Time Allowed: $2^1/_2$ Hrs **2 unit**

Question 1- (20 marks)

a) Explain briefly what you understand as composite structure in Structural Engineering. What advantage does it have over the known reinforced concrete? **(3 marks)**

b) List all the element of composite structure and explain them briefly. Support your answer with diagram (s). **(6 marks)**

c) Explain composite column, state its advantages and examples with diagrams **(5 marks)**

d) Using the data provided below, determine the squash load (compressive resistance) of the stocky column and the tensile resistance of column. Sketch also the position of plastic neutral axis (PNA) parallel to X-X axis of column. Assume that PNA lies at a distance Y into the web of the steel section. Concrete tensile strength is neglected.

Data
Column effective length = 4m
Cover to reinforcement = 30mm

Column size	*400 mm square*		
Steel section	*254 × 254 × 89 kg/m UC*		
Grade S355 steel	p_y	=	$355\,N/mm^2$
Concrete grade	f_{cu}	=	$30\,N/mm^2$ *(normal weight)*
Reinforcement	*4 No. T12 bars*		
	f_y	=	$460\,N/mm^2$

Squash load (compressive resistance) of the stocky column is given by

$$P_u = A_s p_y + A_r \times 0.87 f_y + A_c \times 0.45 f_{cu}$$

Tensile resistance of column

$$P_t = A_s p_y + A_r \times 0.87 f_y$$

(6 marks)

Question 2 - (20marks)

a) State three advantages of composite beam over non composite beam. **(6 marks)**

b) Design a composite floor beam at 3.5m centre spanning 14m. The composite slab is 130mm slab deep. The floor is to resist an imposed load of 5k/N/m^2, partition loading of

1kN/m^2 and a ceiling load of 0.5kN/m^2. Finishes and other loads are ignored. The floor is to be unpropped during construction. Using the following data determine;

i. Under construction-the construction design load, designed moment, moment resistance of the steel section as well as the deflection. Assume the beam to be laterally restrained by the decking. **(6marks)**

ii. Under composite condition- the composite beam designed load, designed moment, resistance of slab in compression, resistance of the steel section in tension as well as moment resistance of composite beam for full shear connection. Moment resistance of composite beam for full shear connection is given as shown in Equation Q2, all the parameters remain as defined in the code and class.

$$M_{pc} = R_s\left\{\frac{D}{2} + D_s - \frac{R_s}{R_c}\frac{(D_s - D_p)}{2}\right\} \quad for\ R_s \le R_c$$

Equation **Q2**

Resistance of slab in compression is given as

$$R_c = 0.45 f_{ca} B_e (D_s - D_p)$$

Resistance of beam in Tension is given as

$$R_s = A p_y$$

(6marks)

Data

Deck:

Profile height D_p = *50 mm*

Trough spacing = *300 mm*

Trough width (average) = *150 mm*

Shear connectors:

19 mm diameter

95 mm as-welded length

Concrete:

Compressive strength f_{ca} = *30 N/mm^2*

Density (lightweight concrete) is 1800 kg/m^3 (dry)
(no extra allowance is made for wet weight – assumed to be included in construction load)

Hint: Try 533 x 210 x82kg/m steel grade S355.

Question 3 - (20marks)

a) What is prestressed concrete? Explain with diagrams listing also the equipment.**(5marks)**

b) State 6 advantages of prestressed concrete over reinforced concrete. **(5marks)**

c) A rectangular beam 400 x 200mm is simply supported over a 6 m span, and supports a live load of 15 kN/m. If a straight tendon is provided at an eccentricity of 75mm below

the centroid of the section, find the minimum prestress force necessary for no tension under live load at mid-span. Calculate the corresponding stresses under self-weight and ultimate load at mid-span and at the ends of the member. **(10marks)**

Question 4 - (20marks)

a) Mention and explain the different methods of prestressing? **(6marks)**

b) What are the limitations in prestressing? **(4marks)**

c) A prestressed rectangular beam 600 mm by 450 mm has a simple span of 7m and is loaded by a uniform load of 30kN/m including its own weight. The prestressing tendon, which is located at an eccentricity of 125mm below the centroid of the section, produces an effective prestress of 1420kN. Compute fibre stresses in the concrete at the mid span and the end of section. **(10marks)**

Question 5 (20marks)

a) Mention and explain the types of structural foundation that you know? Support your answer with diagrams. **(8marks)**

b) A pad foundation is required to support a single square column transferring an axial load only. Using the data provided:

   i. determine a suitable base size,

   ii. check the base with respect to , bending, direct shear, and punching shear, designing suitable reinforcement where necessary. **(12marks)**

Design Data:

Characteristics dead load on column	600kN
Characteristics imposed load on column	500kN
Characteristics concrete strength	fcu= 40N/mm^2
Characteristics strength of reinforcement	fy =40N/mm^2
Net permissible groung bearing pressure	Pg = 200kN/m^2
Column dimensions	350mm x 350mm
Exposure condition	mild