University of Asia Pacific

Department of Civil Engineering

Mid Term Examination Fall 2023

Program: B.Sc. Engineering (Civil)

Course Title: Environmental Engineering III Course Code: CE 431

Time: 1 hour Credit Hour: 2.0 Full Marks: 40

Answer all the questions. Assume reasonable value for any missing data

1) Summarize the factors that are needed for determining future waste quantities. (5)

2) Identify the beneficial consequences of source reduction in relation to climate change. (4)

3) Explain the followings- (3 × 2 = 6)

i. Volatile Combustible Matter ii. Field Capacity

4) Estimate the length of working day for a stationary collection system. (8)

Volume of collection vehicle =16 m^3	Volume of stationary container = 5.5 m^3
Container unloading time= 15 min/container	2 container/ location
q= 0.15 hr/trip	m= 0.016 hr/trip
n= 0.011 hr/km	Time from garage to 1st location = 0.5 hr
Number of collection trip required= 2 trips/day	One way haul distance = 32 km
Container utilization factor= 0.75	Time from garage to last location= 10 min
Average drive time between location = 10 min	
$T_{scs} = PT_{scs} + q + m + nx$	$PT_{scs} = C_t\, uc + (S-1) \times dbc$
$C_t = \frac{V_v z}{V_c f}$	$L = \frac{(t_1 + t_2) + M_{dc} \times T_{scs}}{1 - W}$

5) Compare among various methods of solid waste collection based on level of services and need for scheduled services. (6)

6) (i) Distinguish between primary and secondary collection. (3)

(ii) Use your judgement to decide which collection and transfer system should be adopted based on the following information. (8)

Transportation Costs	Stationary-container system using an 30 m^3 compactor	3500 BDT/hr
	Tractor-trailer transport unit with a capacity of 125 m^3	4000 BDT/hr
Other Costs	Transfer station operating cost	60 BDT/m^3
	Extra cost for unloading facilities for tractor-trailer transport unit	8 BDT/ m^3
Other Data	Density of wastes in compactor	419 kg/ m^3
	Density of waste in transport units	165 kg/m^3

University of Asia Pacific
Department of Civil Engineering
Midterm Examination Fall 2023
Program: B.Sc. in Civil Engineering

Course Title: Structural Engineering V (Prestressed Concrete) Course Code: CE 415
Time: 1 hour Credit Hour: 2 Full Marks: 40

QUESTION 1

A bonded post-tensioned concrete beam carries two live loads of 10 kip each in addition to its own self-weight as shown in Figure 1. At mid-span of the beam, the pre-stressing cable is located at 7 inches from the soffit of the beam. Analyze the beam to obtain the effective prestressing force that can be allowed so that the top fiber compressive stress and bottom fiber tensile stress of concrete at the mid-span of the beam at service condition do not exceed the allowable limits. Assume unit weight of concrete is 150 lb/ft^3, and the 28-day strength of concrete is 5000 psi. Use gross sectional properties for the calculation. **[14]**

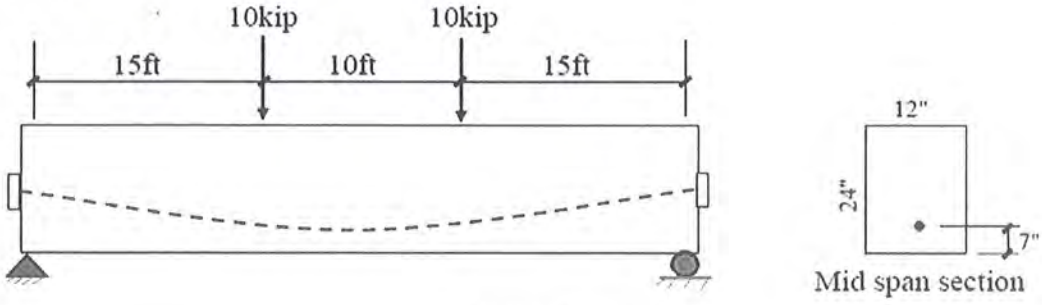

Figure 1

QUESTION 2

A prestressed concrete beam is continuous over two spans, as shown in Figure 2, and its curved cable is to be tensioned from "End A" only. The coefficient of friction is 0.25, and the wobble coefficient is 0.0002 per ft. Analyze the beam to compute the percentage loss due to friction of the entire beam. Divide the cable into few portions for the calculation. **[14]**

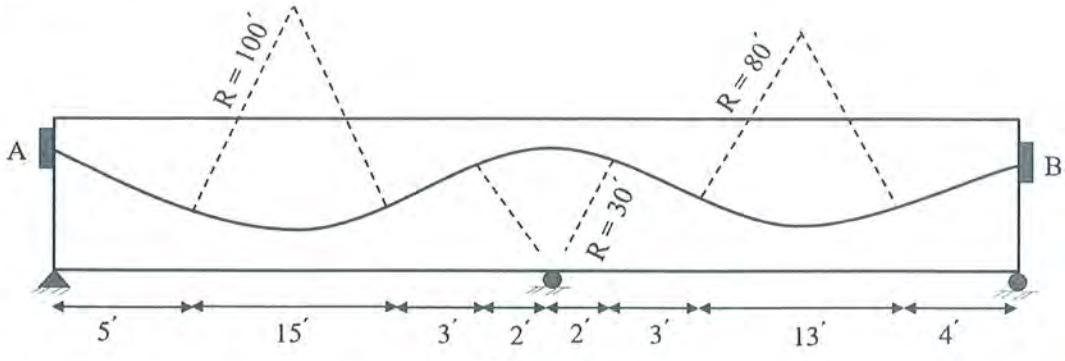

Figure 2

QUESTION 3

(i) State separately the losses of prestress for pre-tensioned and post-tensioned members. **[4]**

(ii) State the advantages of prestressed concrete. **[4]**

(iii) Explain briefly the load balancing concept of prestressed concrete. **[4]**

Formula

1. $0.60\, f'_{ci}$
2. $3\sqrt{f'_{ci}}$
3. $0.45 f'_c$
4. $12\sqrt{f'_c}$

University of Asia Pacific
Department of Civil Engineering
Mid Term Examination Fall 2023
Program: B.Sc. Engineering (Civil)

Course Title: Professional Practices and Communication | Course Code: CE 403
Time: 1 Hour | Credit Hours: 2.00 | Full Marks: 40

Answer all the questions.

1. 'Everything else is work, but not a project.' Explore the quoted statement to elucidate the differences between projects and other work endeavors. **[10]**

2. Apply your concept of the term "Project" to characterize it as a complex and collective work. **[10]**

3. Explore the following scenario:

   Mr. 'X' wishes to undertake an office project, such as evaluating the advantages of implementing new technology to enhance productivity. While discussing this with his Supervisor, Mr. 'X' aims to convince the Supervisor to endorse the concept. The Supervisor, in response, suggests, "Draft a proposal, and I will bring it forward to upper management."

   Examine the described scenario to determine the appropriate type of project proposal relevant in this context. Provide a concise explanation to justify your answer. **[10]**

4. Presume that you own a Civil Engineering Consulting firm specializing in designing R.C.C. buildings and contracting services for implementation. Recently, a client approached you with a project to construct a 1000 sqft duplex building in Cox's Bazar, located in the coastal region of Bangladesh. While your typical practice involves utilizing a Unit Price contract for civil construction projects, one of your trusted contractors, experienced in coastal area projects, is recommending a Fixed Price (Lump Sum) contract for this particular endeavor. Apply your concept of Fixed Price (Lump Sum) and Unit Price Contract to find out the better contract option for this case. Your selection should be backed up by proper justification. **[10]**

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University of Asia Pacific
Department of Civil Engineering
Midterm Examination Fall 2023
Program: B.Sc. Engineering (Civil)

Course Title: Irrigation and flood control **Course Code: CE 461**
Time: 1 hour **Credit Hour: 3** **Full Marks: 20**

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1. a) Explain why the leaching requirement increases when soil moisture stress increases. **(3)**

   b) Do you agree that conjunctive use of water can promote long term sustainable irrigation management in Bangladesh and help decreasing the groundwater table depletion during non-monsoon months in Bangladesh? Justify your answer. **(4)**

2. a) Do you agree that *drip irrigation method* is more appropriate than *furrow irrigation method* for food production in Bangladesh? Justify your answer. **(3)**

   b) Determine the time required to irrigate a strip of land containing clay loam soil from a tubewell with a discharge of 0.17 m^3/s by using border flooding method. The infiltration capacity of the soil may be taken as 1 cm/h and the average depth of flow on the field as **Z** cm. (**Z = 3** + last digit of your registration number). **(2)**

3. a) Do you agree that too much reliance on "embankments" for flood management in Bangladesh is unsustainable in the long run? Justify your answer. **(4)**

   b) Explain how integrated water resources management could help Bangladesh to increase irrigation water availability and irrigation efficiency during non-monsoon months. **(4)**

University of Asia Pacific
Department of Civil Engineering
Midterm Examination – Fall 2023
Program: B.Sc. Engineering (Civil)

Course Title: Transportation Engineering II | Course Code: CE 451
Time: 1 hour | Credit Hour: 3:00 | Full Marks: 60

1. a) Discuss briefly the three layers of flexible pavement that do not contribute to load distribution. (6.0)

   b) Compare between CBR test and Plate Bearing test. (4.0)

   c) Describe the techniques for obtaining penetration grade bitumen from petroleum crude oil. (10.0)

2. a) You have to design an asphalt concrete mixture for a highway pavement containing design ESAL 10^5. Table 1 and 2 show data obtained from sieve analysis and Marshall method. Determine the optimum asphalt content for this mix for the specified limits given in Table 4. (The nominal maximum particle size in the aggregate mixture is 2 in.). Comment on stability of the mixture. Also determine the aggregate proportions to obtain the required gradation for the mix. [Note: it has been found that after the first trial the thickness of the mixture was 60.3 mm] (20+5 +5)

Table 1: Sieve Analysis Results

Sieve designation	% by weight	Bulk Specific Gravity
Retained on 12.5 mm	15-30	3.00
Retained on 2 mm	20-70	3.46
Passing on 2 mm	30-50	2.15
Passing on 0.180 mm	20-65	3.85
Bitumen	5-15	3.06

Table 2: Marshall Method

Asphalt %	Weight of specimen in Air (gm)	Weight of specimen in Water (gm)	Stability with (lb)	Flow (in)	Maximum Specific gravity
4.5	1085	623	1350	5.7	2.46
5.0	1227	874	1570	4.6	3.55
5.5	1136	563	1435	6.2	2.01

   b) Using the information given in question no 2(a), determine the asphalt content absorbed for the optimum mix. The maximum specific gravity for this mixture is 2.33 and the specific gravity of the asphalt is 1.75. (10)

Required Formula:

$$P_{ba} = 100\frac{G_{se} - G_{sb}}{G_{sb}G_{se}}G_b \qquad VMA = 100 - \frac{G_{mb}P_s}{G_{sb}} \qquad P_a = 100\frac{G_{mm} - G_{mb}}{G_{mm}}$$

$$G_{se} = \frac{100 - P_b}{(100/G_{mm}) - (P_b/G_b)} \qquad G_{sb} = \frac{P_{ca} + P_{fa} + P_{mf}}{\frac{P_{ca}}{G_{bca}} + \frac{P_{fa}}{G_{bfa}} + \frac{P_{mf}}{G_{bmf}}}$$

Table 3: Correction factors for Marshall stability values

Volume of specimen (cm^3)	Thickness of specimen (mm)	Correction Factor
457 - 470	57.1	1.19
471 - 482	68.7	1.14
483 - 495	60.3	1.09
496 - 508	61.9	1.04
509 - 522	63.5	1.00
523 - 535	65.1	0.96
536 - 546	66.7	0.93
547 - 559	68.3	0.89
560 - 573	69.9	0.86

Table 4: Suggested Test Limits

(a) Maximum and Minimum Values

Marshall Method Mix Criteria	*Light Traffic $ESAL < 10^4$ (see Chapter 19)*	*Medium Traffic $10^4 < ESAL < 10^6$ (see Chapter 19)*	*Heavy Traffic $ESAL > 10^6$ (see Chapter 19)*
Compaction (No. of blows each end of Specimen)	35	50	75
Stability *N* (lb)	3336 (750)	5338 (1200)	8006 (1800)
Flow, 0.25 mm (0.1 in.)	8 to 18	8 to 16	8 to 14
Air Voids (%)	3 to 5	3 to 5 3.5 to 6.0	3 to 5 6.0 to 7.5

(b) Mineral Percent Voids in Mineral Aggregates

Standard Sieve Designation	*Percent*
No. 16	23.5
No. 4	21
No. 8	18
⅜ in.	16
½ in.	15
¾ in.	14
1 in.	13
1½ in.	12
2 in.	11.5
2½ in.	11

University of Asia Pacific
Department of Civil Engineering
Mid-Term Examination, Fall 2023

Course # CE 441 | Course Title: Geotechnical Engineering II
Full Marks: 40 | Time: 1 hour

Answer to all questions

1. (a) What is geotechnical subsurface exploration? Mention two major purposes of geotechnical subsurface exploration. 1+2 = 3

   (b) Mention (names only) the steps of field investigation phase of a geotechnical subsurface exploration program. Write down any two general guidelines used for selection of number of boreholes. 1+2 = 3

   (c) Summarize your understanding regarding sampler disturbances using Split Spoon Sampler (SSS) and Shelby Tube Sampler (STS). 4

2. (a) Write short note on either Vane shear test or Cone penetration test. 3

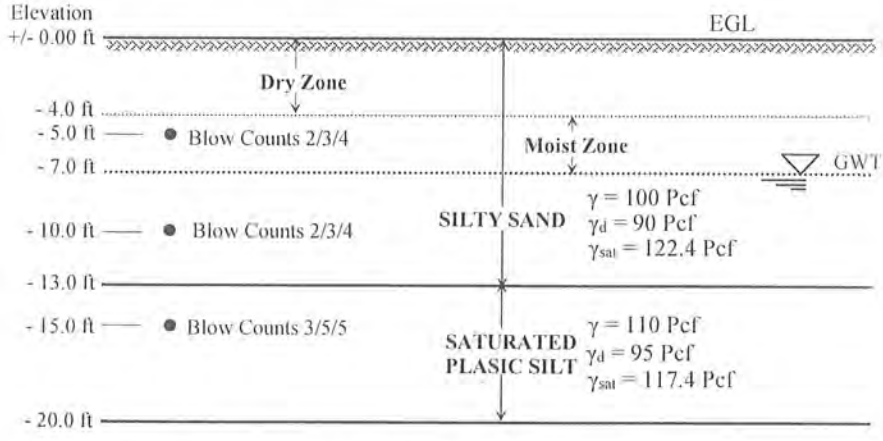
   (b) Utilizing 10% stress criterion and the following considerations the theoretical depth of exploration for a project is estimated 31 feet below EGL. 7

   Considerations:
   Maximum column load = P_{max}; Ultimate bearing capacity = 10.0 ksf; Factor of Safety = 2.5;
   Depth of footing = 10 feet; L = 1.5B

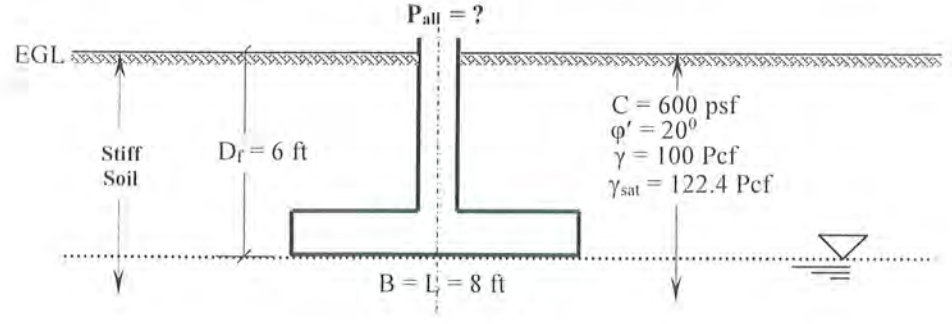
   Determine P_{max} and the dimensions of the footing that were considered for the estimation.

3. Information regarding a geotechnical site investigation conducted at a site at Rangpur is provided below. Estimate the Field SPT values for all depths. Apply necessary corrections (for 60% energy and overburden) and calculate the corrected SPT values as required (Use Appendix, as necessary) at depths of 10 feet and 15 feet below EGL. Also determine the angle of internal friction and cohesion, as applicable at corresponding depths. 10

   Notes: - Use hammer efficiency of 55%
   - SPT was conducted without liner



4. Using Terzaghi's bearing capacity equation (TBCE), determine the allowable column load for long term condition for the following square spread footing. Use F. S. = 2.5. 10



University of Asia Pacific
Department of Civil Engineering
Midterm Examination Fall 2023
Program: B.Sc. Engineering (Civil)

Course Title: Structural Engineering III | Course Code: CE 411
Time: 1 hour | Credit Hour: 3.0 | Full Marks: 4 x 10

ANSWER ALL QUESTIONS. Any missing data can be assumed reasonably.

1. Use stiffness method (neglecting axial deformations) to calculate rotations of joints *c* and *d* of the frame ***abcdef*** loaded as shown in ***Fig.1***
   [Given: EI = 47×10^3 k-ft^2].

2. Ignore zero-force members of the space truss ***abcdefghi*** shown in ***Fig.2*** and apply boundary conditions to formulate stiffness matrix and load vector. A force X_e= 47^k is applied on joint *e* in X direction.
   [Given: S_x = 1000 k/ft, Nodal Coordinates (ft) are *a*(0,20,–6), *b*(0,20,0), *c*(10,20,–3), *d*(0,10,–6), *e*(0,10,0), *f*(10,10,–3), *g*(0,0,–6), *h*(0,0,0) and *i*(10,0,–3)].

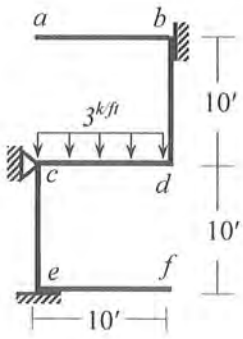


Fig.1

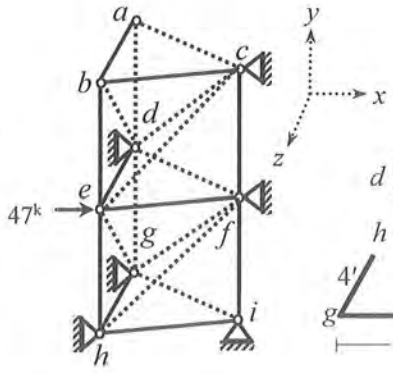


Fig.2

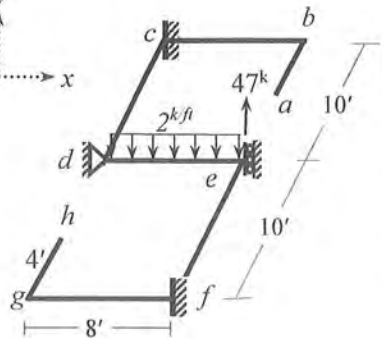


Fig.3

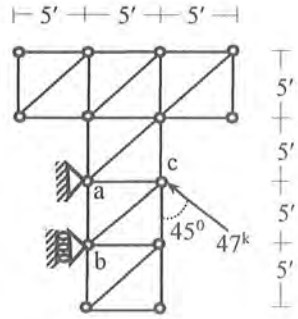


Fig.4

3. Use stiffness method to calculate deflections of joints *d* and *e* of the grid system ***abcdefgh*** loaded as shown in ***Fig.3***
   [Given: EI = 47×10^3 k-ft^2 and GJ = 4.7×10^3 k-ft^2].

4. Identify zero-force members of the truss loaded as shown in ***Fig.4***. Determine the displacements of joint *c*. Also calculate member force of member ***ac***
   [Given: EA/L =1000 k/ft].

List of Useful Formulae for CE 411

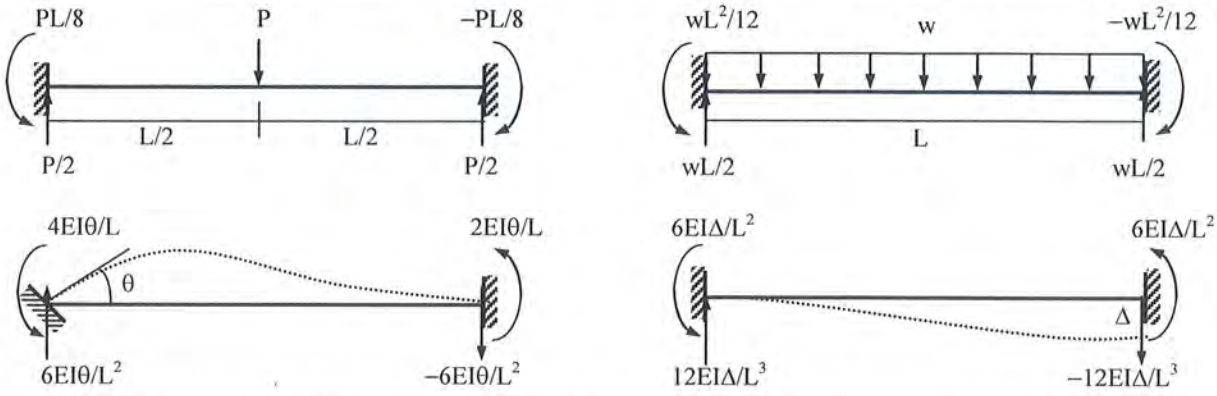
* The stiffness matrix $\mathbf{K_m}^G$ of a 2D truss member in the global axis system is given by

$$\mathbf{K_m}^G = S_x \begin{pmatrix} C^2 & CS & -C^2 & -CS \\ CS & S^2 & -CS & -S^2 \\ -C^2 & -CS & C^2 & CS \\ -CS & -S^2 & CS & S^2 \end{pmatrix}$$

and Truss member force, $P_{AB} = S_x [(u_B - u_A) C + (v_B - v_A) S]$

[where $C = \cos\theta$, $S = \sin\theta$]

Fixed End Reactions for One-dimensional Prismatic Members under Typical Loadings



* The stiffness matrix of a 3D truss member in the global axes system [using $C_x = \cos\alpha$, $C_y = \cos\beta$, $C_z = \cos\gamma$] is

$$\mathbf{K_m}^G = S_x \begin{pmatrix} C_x^2 & C_xC_y & C_xC_z & -C_x^2 & -C_xC_y & -C_xC_z \\ C_yC_x & C_y^2 & C_yC_z & -C_yC_x & -C_y^2 & -C_yC_z \\ C_zC_x & C_zC_y & C_z^2 & -C_zC_x & -C_zC_y & -C_z^2 \\ -C_x^2 & -C_xC_y & -C_xC_z & C_x^2 & C_xC_y & C_xC_z \\ -C_yC_x & -C_y^2 & -C_yC_z & C_yC_x & C_y^2 & C_yC_z \\ -C_zC_x & -C_zC_y & -C_z^2 & C_zC_x & C_zC_y & C_z^2 \end{pmatrix}$$

$C_x = L_x/L$, $C_y = L_y/L$, $C_z = L_z/L$
where $L = \sqrt{[L_x^2 + L_y^2 + L_z^2]}$

* Member force $P_{AB} = S_x [(u_B - u_A) C_x + (v_B - v_A) C_y + (w_B - w_A) C_z]$

* Ignoring axial deformations, the matrices $\mathbf{K_m}^L$ and $\mathbf{G_m}^L$ of a frame member in the local axis system are

$$\mathbf{K_m}^L = \begin{pmatrix} S_1 & S_2 & -S_1 & S_2 \\ S_2 & S_3 & -S_2 & S_4 \\ -S_1 & -S_2 & S_1 & -S_2 \\ S_2 & S_4 & -S_2 & S_3 \end{pmatrix} \qquad \mathbf{G_m}^L = (P/30L) \begin{pmatrix} 36 & 3L & -36 & 3L \\ 3L & 4L^2 & -3L & -L^2 \\ -36 & -3L & 36 & -3L \\ 3L & -L^2 & -3L & 4L^2 \end{pmatrix}$$

where $S_1 = 12EI/L^3$, $S_2 = 6EI/L^2$, $S_3 = 4EI/L$, $S_4 = 2EI/L$

*The general form of the stiffness matrix for any member of a 2-dimensional frame is

$$\mathbf{K_m}^G = \begin{pmatrix} S_xC^2+S_1S^2 & (S_x-S_1)CS & -S_2S & -(S_xC^2+S_1S^2) & -(S_x-S_1)CS & -S_2S \\ (S_x-S_1)CS & S_xS^2+S_1C^2 & S_2C & -(S_x-S_1)CS & -(S_xS^2+S_1C^2) & S_2C \\ S_2S & S_2C & S_3 & S_2S & -S_2C & S_4 \\ -(S_xC^2+S_1S^2) & -(S_x-S_1)CS & S_2S & S_xC^2+S_1S^2 & (S_x-S_1)CS & S_2S \\ -(S_x-S_1)CS & -(S_xS^2+S_1C^2) & -S_2C & (S_x-S_1)CS & (S_xS^2+S_1C^2) & -S_2C \\ -S_2S & S_2C & S_4 & S_2S & -S_2C & S_3 \end{pmatrix}$$