M.Sc

University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2017
Program: M.Sc. Engineering (Civil)

Course Title: Industrial Water and Waste Treatment | Course Code: CE 6305
Time: 3 hours | Full Marks: 100

There are Six (6) questions. Answer any Five (5).

1. (a) How can effluent recirculation improve nitrification in vertical flow wetlands when influent industrial wastewater has higher organic concentration? **[5]**
   (b) Why are intermittent dosing and aeration beneficial for achieving higher nitrogen and organics removal in vertical flow wetlands? **[5]**
   (c) Describe the mechanism of phosphorus removal (from industrial wastewater) employing constructed wetlands. How are pollutants being removed in floating treatment wetlands? **[5+5]**

2. (a) What are the main factors that influence nitrification and denitrification processes in a biological reactor? **[5]**
   (b) Why are two stage anaerobic reactors preferred over single stage systems for sludge treatment in industrial wastewater treatment plants? **[5]**
   (c) Write short notes on: (i) Post D systems; (ii) Bardenpho systems; (iii) Simultaneous phosphorus precipitation systems. **[3.5+3.5 +3]**

3. (a) Why is an in depth knowledge on manufacturing flow diagram of a particular industry (for example tannery industry) required prior to wastewater treatment plant design? **[5]**
   (b) Explain the mechanisms of color compounds removal from dying wastewater employing biological reactors. **[5]**
   (c) How does sludge dewatering occur in continuous belt filter presses? With necessary assumptions derive the following equation: **[5+5]**

   $y_t = L_0(1-e^{-kt})$, where y_t represents BOD_t of the water.

4. (a) "Wastewater is produced at constant rates from slaughter houses"-justify the statement. **[5]**
   (b) Why dissolved air floatation (DAF) unit is an important part of a slaughterhouse wastewater treatment plant? Enlist the factors for improving pollutant removal performance of such DAF unit . **[5]**
   (c) What is the function of anaerobic pond for the treatment of animal wastewater? How does foaming occur in aerobic units of animal wastewater treatment plants? **[5+5]**

5. (a) How does seasonal variation influence industrial wastewater generation rates? **[5]**
   (b) Explain the pre-requisites for establishing central effluent treatment plants (CETP). **[5]**
   (c) Illustrate the differences between CSTR and plug flow reactors. Describe the working principles of rotating biological contactor (RBC) reactors. **[5+5]**

6. As an environmental manager you have been assigned to propose wastewater treatment plants for a textile industry and a seafood processing industry. Wastewater characteristics of these industries are being provided in the following table. Propose wastewater treatment diagrams for these industries and justify your selections. **Textile wastewater treatment plant will include activated sludge process and seafood processing wastewater treatment plant will include a combination of activated sludge process and constructed wetland systems.** **[20]**

Industry	Parameter	Unit	Concentration
Textile	pH	---	11.0
	DO	mg/L	0.9
	Suspended solids		330.0
	BOD_5		90.0
	COD		980.0
	NH_4-N		8.0
	NO_3-N		3.0
	Total Nitrogen		27.0
	Total Phosphorus		6.0
	Color	TCU	670.0
Seafood	pH	---	6.0
	DO	mg/L	0.7
	Suspended solids		1000.0
	BOD_5		400.0
	COD		2000.0
	NH_4-N		30.0
	NO_3-N		10.0
	Total Nitrogen		90.0
	Oil and grease		50.0
	Total Phosphorus		6.0

University of Asia Pacific

M.Sc in Civil Engineering, Final Exam, Spring 2017 Semester

CE 6609: River Engineering

Marks: 100 Time : 3 hour

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There are 11 questions below. Question No. 11 is compulsory and answer any 8 from Question No. 1 to Question No. 10.

1) Explain the processes and causes of meandering of a river. Show with neat sketches a typical cross-section of a braided river. **(10)**

2) Describe the main features and hydrological aspects of Brahmaputra-Jamuna river. Also write down the morphological characteristics of Padma river. **(10)**

3) With neat sketches show (i) the processes of surface erosion at river banks, (ii) processes responsible for mass failure of a river bank. **(10)**

4) Describe the main features and characteristics of revetment type bank protection works. Show with neat sketches the different types of scour around a deflecting groyne. **(10)**

5) Explain the possible failure mechanisms in RCC spurs. Mention the environmental and natural causes of river bank failure. **(10)**

6) Explain the phenomena of Micro stability and Flow slides in context to river bank revetment stability. **(10)**

7) Mention the importance of filter in the stability of river bank protection revetment. Explain the considerations during design of filter for revetment slope and falling apron for different protective elements as cover layer. **(10)**

8) Describe the considerations for estimating (i) flow velocity (ii) discharge for design a river bank protection work. **(10)**

9) Explain the calculation of different types of Scour based on local geometry of the river. **(10)**

10) Explain the erosion resistance to sub-soil for non-cohesive and non-cohesive sediments. **(10)**

11) The design data of a river is given below. Design a bank protection revetment considering (i) cc block single layer (ii) rock as protection material. Also design the launching apron. **(20)**

Design Data:

Discharge (Q):	100,000.00	m^3/sec	100 yr flood
Velocity (u):	2.20	m/sec	
High Water Level (HWL):	6.00	m, PWD	
Av.Low Water Level (Av.LWL):	0.50	m, PWD	
Flood Plain Level (FPL):	4.00 - 5.00	m, PWD	

Wind velocity:	20.00	m/sec	
Wind Duration:	1.50	hr	
Fetch length:	5.0	km	
Significant wave height (Hs):	1.25	m	25 yr return period
Wave Period:	4.0	secs	
Bank slope, above low water (1V:2.5H):	20	°	
Bank slope below low water (1V:2H):	30	°	
Depth Factor (h/d): (from field observation)			

ρ_w = Density of water =	1000	kg/m^3
ρ_s = Density of concrete by stone shingles =	2250	kg/m^3
ρ_s = Density of stone boulders/Rocks =	2650	kg/m^3
φ_{sc} = stability factor (for current) =	0.65	[-]
Ψ_{cr} = critical shear stress parameter (Shields for cc block)=	0.035	[-]
K_τ = Turbulance factor = 1.5, for mild outer bends of rivers		
K_h = depth factor = $(h/D_n+1)^{-0.2}$		[-]
K_s = Bank normal slope factor = $[1-(\sin\alpha/\sin\varepsilon_s)^2]^{1/2}$;(for specific material)		[-]
h= average water depth (average depth of water at bankfull stage)	9.0	[m]
k_s = bed roughness coefficient =		[m]

H_s = significant wave height [m]	1.25	m
Ψ_u = system specific stability upgrading factor [-]	2.00	[-] (cc block)
Φ_{sw} = stability factor for wave loads [-]	2.25	[-](cc block)
T_m = mean wave period [s] =	4.2	secs
b = wave structure inter action coefficient [-] =	0.67	(cc block)

Assume the reasonable value of any missing data

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University of Asia pacific
Department of Civil Engineering
Final Examination
Spring 2017
Program: M.Sc Engineering (Civil)

Course Title: Traffic Engineering **Course Code: CE 6506**
Full Marks: 150 **Time: 3 hours**

There are **six** questions. Answer five of them

1. a) Define Transportation System Management. What are the objectives of Transportation Demand Management (TDM)? 10
   b) Enumerate some demand management techniques to alleviate traffic congestion and explain any three of them. 20

2. a) Compare angular and parallel method of parking. 10
   b) The following spot speeds (km/hr) were observed for 30 vehicles traversing a segment of a highway. 20
   35, 39, 42, 73, 55, 64, 57, 46, 73, 38, 45, 49, 32, 28, 54, 56, 48, 57, 74, 66, 35, 39, 42, 55, 49, 48, 44, 43, 38, 69.
   Calculate the design speed, average speed, safe speed, median speed and lower limit of speed. (Consider pace as **11-20, 21-30** and so on).

3. a) Design a two-phase signal at an isolated cross-junction for the following data: 12
   Intergreen for N-S: 7 sec and E-W: 8 sec. Lost time due to starting and end delays : 4 sec (N-S) and 3 sec (E-W)

	N	S	E	W
Flow(q), veh/hr	770	640	730	990
Saturation flow(s) veh/hr	2100	2250	2590	2650

   Assume any missing data. Draw bar diagram.
   b) What are the principle techniques of traffic calming device? Briefly describe any one of the techniques for traffic calming. 12
   c) Concisely discuss the device which is most suitable for emergency rescue route. 6

4. a) Write notes on the following (any **four**): 20
   i) Glare recovery
   ii) Park and ride system
   iii) Stopping sight distance
   iv) Time-mean and space-mean speed
   v) Congestion pricing
   b) An urban primary road with 70 ft pavement width having a reflectance of 11% carries a maximum of 1400 vph at night-time. Design the lighting system considering Tungsten source with mounting height of 45 ft and a maintenance factor of 0.78. Draw the lighting layout. 10

5. a) A sag vertical curve is to be designed to join a +6% grade with a -4% grade at a section of a two-lane highway. The design speed of the highway is 50 mph. Determine the minimum length of the curve. 12
   b) In section of a freeway with a level terrain what safe stopping distance must be 10

provided? The highway having design speed of 70 mi/hr. Assume coefficient of friction equal to 0.3. 8

c) What are the goals of traffic engineering?

6. a) Concisely describe the necessity of accident data for engineering uses. 12

b) List the levels of data sets considered for accident analysis. 6

c) A horizontal curve with a radius of 850 ft is designed for a two-lane highway having a design speed of 75 mph. If the section of highway is having a 6% downgrade and coefficient of friction is 0.348, determine the smallest possible distance of any object can be placed from the centerline of the inside lane of the curve. Assume PR time 2.5 sec. 12

Necessary equations:

$$S<L: \quad L=\frac{AS^2}{100(\sqrt{2h_1}+\sqrt{2h_2})^2}$$

$$S>L: \quad L=2S-\frac{200(\sqrt{h_1}+\sqrt{h_2})^2}{A}$$

$$S<L: \quad L=\frac{AS^2}{200[2.0+S(\tan 1^\circ)]}$$

$$S>L: \quad L=2S-\frac{200[2.0+S(\tan 1^\circ)]}{A}$$

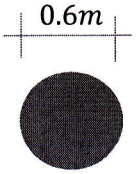
University of Asia Pacific
Department of Civil Engineering
Final Examination Spring 2017
Program: Master in Civil Engineering

Course Code: CE 6115 | **Time: 180 Minutes**
Course Title: Structural Dynamics I | **Full Marks: 200**

Answer any 10 of the following 14 Questions. Any missing data can be assumed reasonably.

[1] (a) Determine the damped, undamped natural frequencie, natural period, damping constant of a single-storey reinforced concrete building that has a floor size of $7m \times 6m$ and floor-to-floor height $5m$. Given, floor thickness = $0.20m$, damping ratio is 4.5%, there are 12 columns and the size is given in Fig. 1, $E = 44821$ MPa . **(14)**

(b) An acceleration trajectory is given by $\ddot{x}(t) = -50{\omega_n}^2 \sin(\omega_n t + \emptyset)$. Given, $\emptyset = 14^\circ$, $\omega_n = 4.25\ \frac{rad}{sec}$, $t = 0{:}\,0.15{:}\,0.3$. Estimate the displacements. **(6)**



Columns x-section

Fig.1

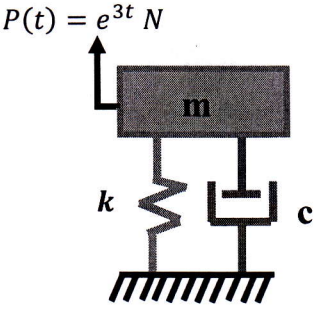


Fig. 2

[2] Derive and solve the equation of motion of a SDOFs shown in Fig. 2 to determine acceleration at time t = 5sec. Given, the system has 1% damping, $m = 600$ Kg, $k = 8000\ \frac{N}{m}$, $E = 2 \times 10^{11}\ \frac{N}{m^2}$, $t = 0$, $x(0) = 0.1$ m, $\dot{x}(0) = 1\ \frac{m}{sec}$. **(20)**

[3] Solve Question [2] numerically to estimate acceleration by using Constant Average Acceleration (CAA) method for the time steps t = 0:0.23:0.46 sec. Assume all the system information given in Question [2]. **(20)**

[4] (a) Explain damped forced and damped free vibration. **(3)**

(b) What do you understand by damped and undamped system? Which one you would expect in real life problem? Why? **(6)**

(c) Sketch different type of dynamic loads. How much damping you would expect in structures? **(4)**

(d) Your client is planning to build a 40-storied hotel in Cox's Bazar. What you would advise him to do in order to be safe from dynamic loads? Why? **(7)**

[5] An undamped SDOF system is subjected to external force $P(t) = t^2 + e^{3t}\ N$. Derive and solve the equation of motion to determine the displacement, velocity and acceleration at time t =1.5 sec. Given, $m = 700$ Kg, $k = 9500\ \frac{N}{m}$, $t = 0$, $x(0) = 0.05$ m, $\dot{x}(0) = 0.5\ \frac{m}{sec}$. **(20)**

[6] (a) What is the purpose of Modal Analysis? **(3)**

(b) Why do we need Eigenvalue analysis? What is mode shape? Is mode shape important? If yes, then why? **(6)**

(c) How many modes we can have for a SDOFs, 2-DOFs and 3-DOFs? Draw their qualitative mode shapes? **(6)**

(d) Which mode is crucial for any dynamical system and why? **(5)**

[7] Determine the Eigenfrequencies and Mode Shapes of a 2-DOFs. Given, $m_1 = 25$ Kg, $m_2 = 25$ Kg, $k_1 = 5\ \frac{kN}{m}$, $k_2 = 4\ \frac{kN}{m}$. **(20)**

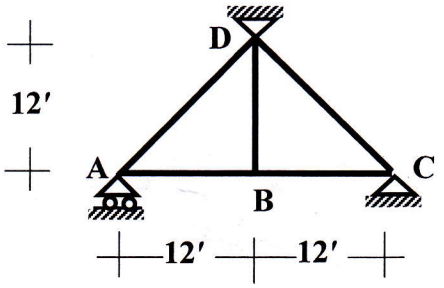
[8] Perform the Modal Analysis to determine the displacements of the 2-DOFs given in Question [7] at t = 0.2 sec. Given, $\begin{Bmatrix} p_1 \\ p_2 \end{Bmatrix} = \begin{Bmatrix} 3t \\ 5t^2 \end{Bmatrix}$ N, $C = [0.25M + 0.1K]\ \frac{N-s}{m}$. **(20)**

[9] Use Newmark-Beta Method to calculate accelerations of a 2-DOFs for time steps $t = 0{:}\,0.14{:}\,0.28$sec. Given, $\begin{Bmatrix} x_1(0) \\ x_2(0) \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0.11 \end{Bmatrix}$ m, $\begin{Bmatrix} \dot{x}_1(0) \\ \dot{x}_2(0) \end{Bmatrix} = \begin{Bmatrix} 0 \\ 1.1 \end{Bmatrix} \frac{m}{sec}$, $\begin{Bmatrix} p_1 \\ p_2 \end{Bmatrix} = \begin{Bmatrix} 5e^{2t} + 20 \\ 2e^{3t^3} \end{Bmatrix} N$, $m_1 = 250$ Kg, $m_2 = 205$ Kg, $k_1 = 50\ \frac{kN}{m}$, $k_2 = 40\ \frac{kN}{m}$, $C = [0.05M + 0.15K]\ \frac{N-s}{m}$. **(20)**

[10] (a) What is the purpose of Frequency Domain Analysis? What is Transfer Function? **(6)**
(b) Determine the Transfer Function of the SDOFs shown in Fig. 2. And calculate the value of the response function for $\omega = 0{:}\,0.5{:}\,0.1\ \frac{rad}{sec}$. **(14)**

[11] Use consistent mass matrices to calculate the natural frequencies of the plane truss shown in Fig. 3. Given, E = 30000 ksi, A = 4 in^2, m = 3×10^{-6} k-sec^2/in^2. **(20)**

Fig. 3



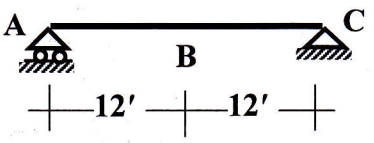


Fig. 4

[12] Determine the approximate first natural frequency of a simply beam shown in Fig 4, in transverse direction, analyzing with (i) one lumped-mass element, (ii) one consistent-mass element. Given, E = 46x10^4 ksf, I = 0.12 ft^4, m = 0.005 k-sec^2/ft^2. **(20)**

[13] (a) Draw a typical response of a SDOF and 2-DOF systems in Frequency Domain? **(4)**
(b) What are the differences between exact and numerical solutions? Explain how you can improve your numerical results? **(5)**
(c) Explain the effect of amplitudes, natural periods, phase shift and damping with appropriate sketches. **(6)**
(d) Your client has asked you to design a single storey building that has 1.32 Hz resonant frequency. What parameter(s) you would consider for designing that building? **(5)**

[14] (a) Do you think dynamic analysis is necessary? If yes, then why? **(3)**
(b) Assume that three different buildings have the resonant frequencies of 1, 2 and 3 Hz. Determine their corresponding natural periods, angular frequencies, and mass stiffness ratios. **(7)**
(c) Your assistant has provided you a plot that has time history of displacement, velocity and acceleration. How you can quickly check (without doing detail calculation) the whether the results are okay or not? **(6)**
(d) Why higher modes are not so important for linear structures? **(4)**