

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject:** - Ground Water Engineering (CE76509) (Elective II)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

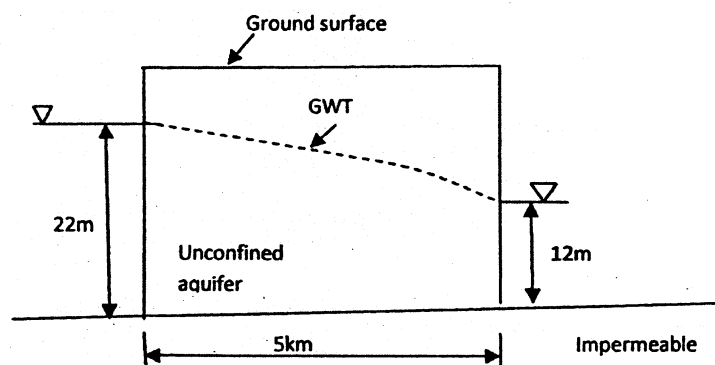
1. Define specific yield, specific retention and storage coefficient. [3]

2. (a) Starting from general expression of Darcy's law for groundwater flow, derive 3 dimensional form of groundwater equation. [7]

(b) A fully penetrating well is pumped at a constant rate of  $900 \text{ m}^3/\text{hr}$  from a confined aquifer of 30m thick and average grain diameter 1mm. What is the domain around the well for which Darcy's law is applicable? Assume that Darcy's law is valid up to Reynold's no. ( $Re$ ) = 5 and kinematic viscosity of water = 1 centistoke. [7]

3. (a) Explain how the water table contour maps are prepared and state their uses. [3+5]

(b) Two rivers are separated by a homogeneous unconfined aquifer of 5km. Compute the seepage flow per unit length of the river if  $K = 13\text{m/day}$ . Also give the equation of phreatic line. [6+2]



4. (a) Discuss the Theis solution for unsteady flow into a well in a confined aquifer. Also write down Theis's assumptions. [4+3]

(b) A 30cm diameter well penetrating an unconfined aquifer of 25m thick below water table is pumped at a uniform rate of 650litr/min, till the water level in the well becomes steady. Two observation wells drilled radially at a distance of 30 and 90m from the center of the well, show depression of 3.5m and 1.3m respectively. [4+4+4]

I) Determine the permeability of the aquifer.

II) Determine the drawdown at the main well.

III) At what distance from the well the drawdown is insignificant?

5. (a) Explain Cooper and Jacob method for the determination of storage coefficient and transmissivity of aquifer using time-drawdown data. [7]
- (b) During a recuperation test conducted on an open well in a region, the water level in the well was depressed by 2.75m and it was observed to rise by 1.6m in 80 minutes. [3+4]
- I) What is the specific yield of open wells in that region?
- II) What could be the yield from a well of 5m diameter under a depression head of 2.3m?
6. (a) Explain electrical resistivity method for the exploration of groundwater. [5]
- (b) Explain the working principle, advantages and limitations of centrifugal pump used for lifting groundwater. [5]
- (c) Discuss about the aquifer system of the Kathmandu valley of Nepal. [4]

\*\*\*

**Examination Control Division**  
2070 Chitra

Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject:** - Dynamics of Structure (EL104CE) (Elective I)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Generate stiffness matrix for the structure shown in Figure 1. Take  $E = 200 \text{ GPa}$ ,  $I = 4.0 \times 10^6 \text{ mm}^4$ . Find the force vector in terms of the displacement at the coordinates you define. (16)



Figure 1

2. Perform a free vibration analysis as a part of the overall structural design, of a single bay frame consisting of a uniformly distributed load of  $30 \text{ kN/m}$ . The section of the frame is  $250 \text{ mm} \times 250 \text{ mm}$ ,  $E = 2.0 \times 10^4 \text{ MPa}$ . The frame consists of a beam of span  $5 \text{ m}$  and  $3 \text{ m}$  high columns. Where can we use the outcomes of the analysis? (14+2)
3. A structure is modeled as a damped oscillator with spring constant  $k = 5.5 \times 10^3 \text{ kN/m}$  and undamped natural frequency  $\omega = 25 \text{ rad/sec}$ . Experimentally it was found that a force  $4.5 \text{ kN}$  produced a relative velocity of  $25 \text{ mm/sec}$  in the damping element. Find: (a) the damping ratio  $\xi$ , (b) the damped period  $T_D$  (c) the logarithmic decrement  $\delta$ , and (d) the ratio between consecutive amplitudes. (7+3+3+3)
4. A concrete frame supports a rotating machine which exerts a horizontal force at the girder level,  $F(t) = 900 \sin 5.3t \text{ N}$ . Assuming 5% of critical damping, determine: (a) the steady-state amplitude of vibration and (b) the maximum dynamic stress in the columns. Assume that the girder is rigid. The frame is single bay, has a column size  $250 \text{ mm} \times 250 \text{ mm}$ ,  $E = 2.1 \times 10^7 \text{ kN/m}^2$  and a height  $3.0 \text{ m}$ . Weight of the structure  $67.5 \text{ kN}$  is lumped at its floor level. (16)
5. Estimate the maximum response of the frame shown in Figure 2 subjected to the loads shown. Neglect damping. (16)

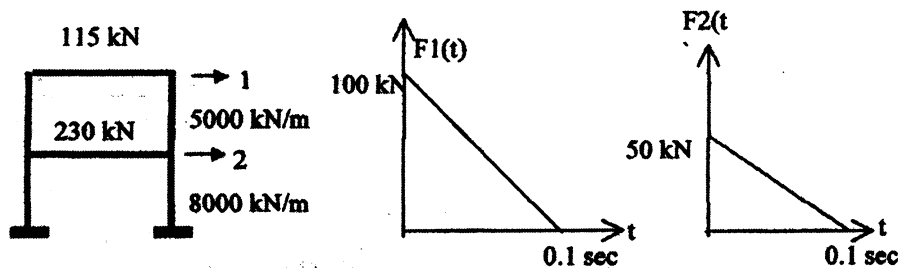


Figure 2

6. a) A displacement pattern was found from static analysis as shown in Figure 3. Estimate the fundamental natural frequency of the system? Employ the Raleigh method. (8)

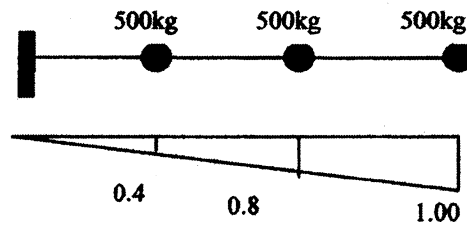


Figure 3

- b) Determine the normal functions for free longitudinal vibration of a bar of length  $l$  and uniform cross section. One end of the bar is fixed and the other is free. (8)

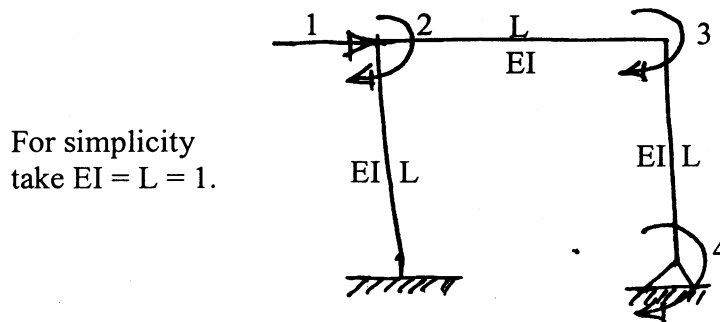
\*\*\*

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

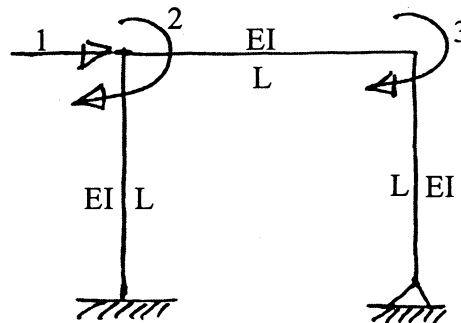
**Subject: - Dynamics of Structures (Elective I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Four** questions **Question No. 1 is compulsory.**
- ✓ The figures in the margin indicate **Full Marks.**
- ✓ Assume suitable data if necessary.

1. a) Derive the  $4 \times 4$  stiffness matrix  $[K]$  for the structure shown in figure below. [10]



- b) In the  $4 \times 4$  stiffness matrix  $[K]$  generated in 1(a), compute the reduced  $3 \times 3$  stiffness matrix for the structure shown in figure below. [10]



2. a) For the system shown in figure below, mass  $m = 91,000$  kg and  $v(0) = 30$  mm. If the maximum displacement on the return swing is 20 mm at 0.5 sec., determine: [10]

- i) The damping ratio
- ii) The damping constant
- iii) The spring constant

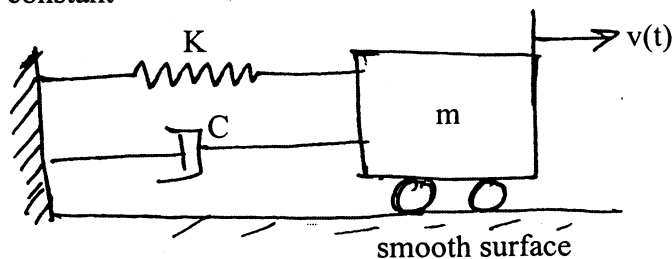
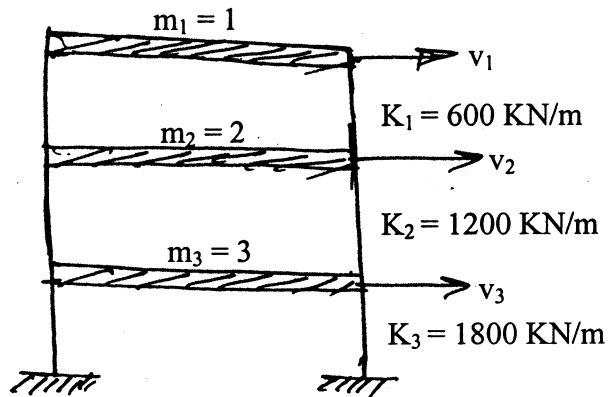


Figure: Mass-spring system of modelling of SDOF system

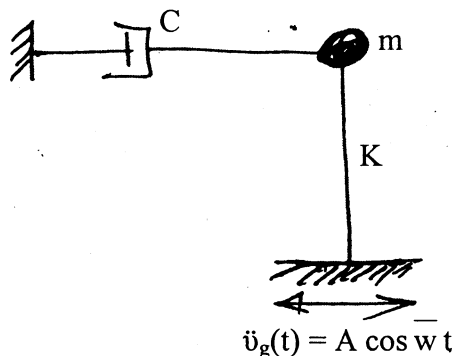
- b) A machine of 200 kg mass is supported on four parallel springs of total stiffness 750 N/m has an unbalanced rotating component which results in a disturbing force of 350 N at a frequency of 2121 rpm. If the damping ratio is 0.2, determine: [10]

- i) Amplitude of motion due to the unbalance
- ii) Transmissibility (TR)
- iii) Transmitted force

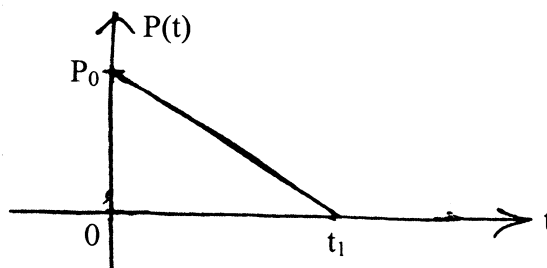
3. a) Determine the natural frequencies and mode shapes for the shear building as shown. Draw the mode shapes and write down the modal matrix. [1]



- b) Demonstrate numerically that the computed mode shapes satisfy the orthogonality conditions with respect to mass only. [5]
4. a) Determine the steady-state response of the given system under the ground excitation as  $\ddot{u}_g(t) = A \cos \omega t$ . [12]



- b) A SDOF system is subjected to a triangular pulse load of amplitude  $P_0$  and duration ' $t_1$ ' as shown in the figure below. Determine the response of the undamped system. [8]



5. Write in brief with necessary relationships: (any four) [4×5]

- Equations of constraints and dependent measurements
- Dynamic magnification factor and response ratio
- Improved version of Rayleigh's method
- Duhamels integral and its solution
- Equations of motion for transverse vibration of a string, transverse vibration of a beam and axial vibration of a rod with associated boundary conditions
- Mode superposition method

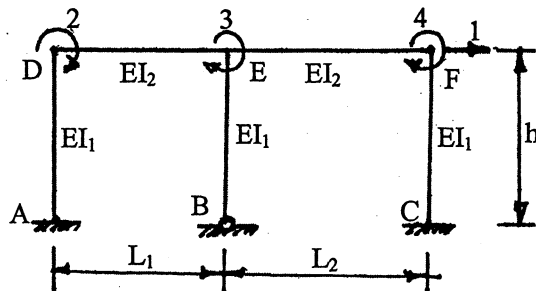
\*\*\*

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject:** - Dynamics of Structures (*Elective I*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Four** questions. **Question No. 1 is compulsory.**
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Use proper and consistent unit system.
- ✓ Assume suitable data if necessary.

1. a) Generate the stiffness matrix  $[k]$  for the structure with the coordinates indicated in the figure given below. [12]



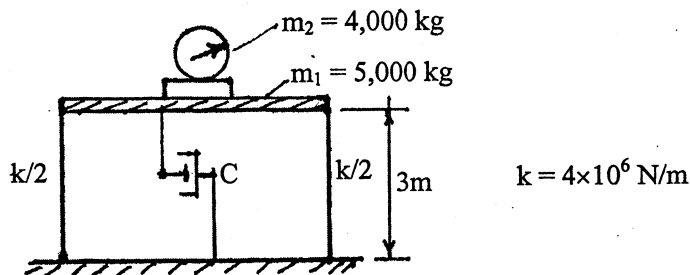
- b) In the  $4 \times 4$  stiffness matrix  $[k]$  generated in #1(a), put  $EI_2 = 2$ ,  $h = 1$ ,  $L_1 = 1$ ,  $L_2 = 2$  and  $EI_1 = 1$ . Then derive the reduced stiffness coefficient  $k$  considering only coordinate 1 defined for the structure using the  $4 \times 4$  stiffness matrix  $[k]$  generated. [8]

2. a) An elevated tank is mounted on a hollow shaft. The tank is pulled by a horizontal force of 36 kN. The tank is pulled by 6cm and the cable is cut suddenly to enable the tank to vibrate freely. The free vibrations are recorded. At the end of 10 complete cycles the time was recorded as 4 seconds and amplitude as 1.5cm. From this data determine the followings: [10]

- i) damping ratio,  $\xi$
- ii) natural period of undamped vibration
- iii) effective stiffness
- iv) effective weight
- v) damping coefficient

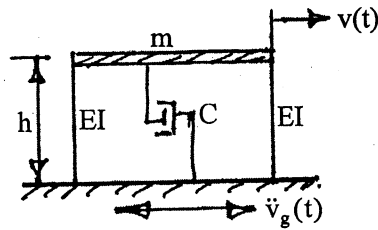
- b) The frame shown in the figure below has a reciprocating machine put on it. The mass of this is to be allowed for. The machine exerts a periodic force of 8.5 kN at a frequency of 1.75 Hz. Determine: [10]

- i) the steady-state amplitude of vibration if  $\xi = 4\%$
- ii) the steady-state amplitude if the forcing frequency was in resonance with the structure



3. a) The single storey structure shown below may be modeled as a SDOF system with the roof as a rigid slab. Determine the response of the building when the base (ground) undergoes a horizontal motion defined by  $\ddot{v}_g(t) = \ddot{v}_{g0} \sin \bar{\omega} t$ .

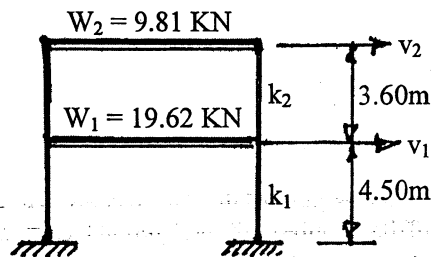
[12]



- b) What is dynamic magnification factor? What are the factors influencing dynamic magnification factor? Explain with suitable curves plot.
4. a) A two-storey building is modeled as a shear building as shown in the figure below. The weights of the floors are  $W_1 = 19.62$  KN and  $W_2 = 9.81$  KN. The total stiffness of the first floor columns is  $k_1 = 175$  KN/m, while the total stiffness of the second floor column is  $k_2 = 148.75$  KN/m. Determine the natural frequencies and natural vibration mode shapes of the building. Sketch the mode shapes.

[8]

[12]



- b) Describe, in detail, without calculations, how to determine the response  $\begin{Bmatrix} v_1 \\ v_2 \end{Bmatrix}$  of the structure given in #4(a) due to the load vector  $\begin{Bmatrix} P_0 \sin \bar{\omega} t \\ 0 \end{Bmatrix}$ .

[8]

5. Write in brief with necessary relationship. (any four)

[4×5]

- Equations of constraint and dependent measurements
- Eigen value problems
- Inversion of matrices (Stiffness or flexibility) by partitioning
- Staudula's method of practical vibration analysis
- Partial differential equations of transverse vibration of a string and beam, and axial vibration of a rod
- Mode superposition method

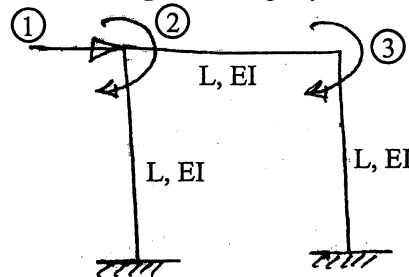
\*\*\*

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Dynamics of Structures (Elective I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Four** questions. **Question No. 4 is compulsory.**
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Use proper and consistent unit system.
- ✓ Assume suitable data if necessary.

1. a) Find the inverse of the stiffness matrix  $[k]$  for the structure shown in the figure given below. What does the resulting matrix signify? [10]



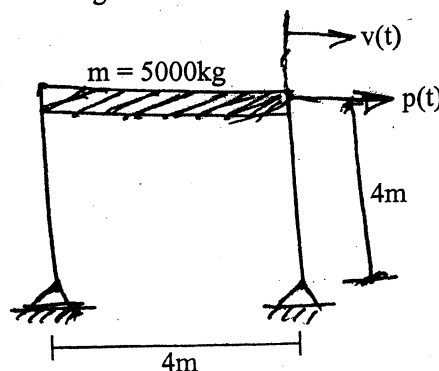
For simplicity  
 $EI = L = 1$

- b) Consider only co-ordinate (1) defined for the structure of Q.N. 1(a) in above figure, derive the reduced stiffness coefficient  $K$  using the  $3 \times 3$  stiffness matrix of the same structure. [10]
2. a) A platform of weight  $W = 18$  kN is being supported by four equal columns which are clamped to the foundation as well as to platform. On testing, it was found that a static force of 4.5 kN applied horizontally to the platform produces a displacement of 2.5 mm. If the damping of the structure is of order of 5% of the critical damping, determine the followings for the structure, [10]

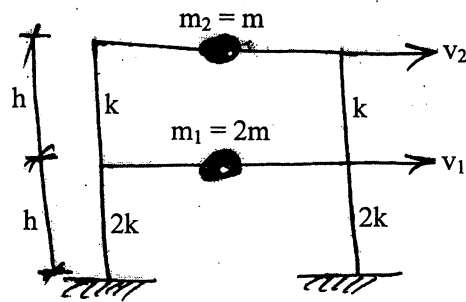
- i) Undamped natural frequency ( $\omega$ )
- ii) Absolute damping coefficient ( $c$ )
- iii) Logarithmic decrement ( $\delta$ )
- iv) The number of cycles and time required for the amplitude of motion to be reduced from an initial value of 2.5 mm to 0.25 mm.

- b) A machine part of mass 1.95 kg vibrates in a viscous medium. Determine the damping coefficient when a harmonic exciting force of 24.46 N results in a resonant amplitude of 1.27 cm with a period of 0.20 seconds. [10]

3. a) A steel rigid frame, as shown in figure, supports a rotating machine which exerts a horizontal force of  $50,000 \sin 11t$  N at the girder level. Assuming 4% critical damping, what is the steady state amplitude of vibration?  $I$  for columns =  $1500 \times 10^{-7} \text{ m}^4$ ,  $E = 2.1 \times 10^{10} \text{ N/m}^2$ . Also calculate the transmissibility of motion of the girder. The girder may be assumed to be rigid. [12]



- b) Define unit impulse and unit impulse response function. Write down the expression for Duhamel integral for damped and undamped system of vibrations. Also enumerates the limitations of Duhamel integral. [8]
4. a) Determine the natural frequencies and mode shapes of the system as shown in figure for two storey shear frame building. Sketch the corresponding mode shapes. [12+4]



- b) Write down the fundamental principles and procedures of the mode superposition method for analysis of MDOF system. [6]
5. Write in brief with necessary relationships (any four only): [4×5]
- Orthogonality properties of mode shapes
  - Transverse vibration of a string
  - Improved version of Rayleigh's method
  - Vibration isolation and transmissibility
  - Dynamic magnification factor and response ratio
  - Principle of superposition of displacements

\*\*\*

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject:** - Soil Conservation and Watershed Management (*Elective I*) (CE725)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. (a) What are the objectives of watershed management? [3]  
(b) Design a parabolic shaped grassed waterway to carry a flow of  $2.0 \text{ m}^3/\text{s}$  down a slope of 3%. The waterway has a good stand of grass and a velocity of  $1.75 \text{ m/s}$  can be allowed. Take Manning's  $n = 0.045$ . [8]
2. (a) Differentiate between rill and sheet erosion. [4]  
(b) Explain sand dams with sketch. [6]  
(c) The data obtained from a field plot where no soil conservation practice has been used is as under: [4]  
 $A = 10 \text{ t/ha/year}$ ,  $R = 40$ ,  $C = 0.35$ ,  $LS = 1.2$ . Determine the value of  $K$  using USLE equation.
3. (a) Describe contour cultivation and strip cropping technique for soil conservation. [6]  
(b) In a hilly region, a bench terrace is proposed for cultivation purpose. The general land slope is 20%. Average soil depth is about 1m. Riser is to be laid on 1:1 gradient. The intensity of rainfall of the area is  $15 \text{ cm/hr}$  for the duration equal to time of concentration. Design the inward sloping bench terrace. (Take  $C = 0.6$ ). [8]
4. (a) Describe briefly the different types of water conservation methods for cropland. [8]  
(b) Determine the depth of flow in a surplusing structure, having design length equal to 1.7m. Surplus water is due to  $73 \text{ mm/hr}$  rainfall from  $0.9 \text{ km}^2$  catchment. Assume necessary data suitably. [6]
5. (a) Define check dams and explain different types of them with sketch. [6]  
(b) Calculate the minimum bottom width required for a dam of height 6.5m. Maximum depth of water to be impounded is 5.8m and the face in contact with water is vertical. Take top width = 1.5m, density of masonry =  $2.2 \text{ gm/cc}$  and density of water =  $1 \text{ gm/cc}$ , coefficient of friction between masonry and earth = 0.5. [9]
6. Write short note on: (any three) [3x4]
  - (a) Stream bank protection
  - (b) Wattling and mulching
  - (c) Causes and consequences of watershed deterioration
  - (d) Land capability classification

\*\*\*

06D TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2070 Chitra

Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject:** - Soil Conservation and Watershed Management (*Elective I*) (EL112CE)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. (a) Explain the different factors which influence watershed management. [8]  
(b) The data obtained from a field plot where no soil conservation practice has been used is as under:

Season	A (t/ha/yr)	R	C	LS
Winter	15	35	0.35	1.1
Spring	80	350	0.5	1.1
Summer	20	750	0.4	1.1
Fall	1	10	0.2	1.1

Determine the average value of K. [8]

2. (a) Determine the depth of flow in a surplusing structure, having design length equal to 1.4m. Surplus water is due to 50mm/hr rainfall from 0.91 km<sup>2</sup> catchment. Assume necessary data suitably. [6]  
(b) Differentiate between contour bund and graded bund. [4]  
(c) Explain gully erosion and rill erosion. [6]

3. (a) A masonry dam is 6m high, 1m wide at the top and 4m at the bottom, and has a vertical water face. The dam impounds water to a height of 3.3m. Calculate the magnitude of resultant force and its point of application with the base when the reservoir is full and when it is empty. Take density of masonry = 2.2gm/cc and density of water = 1gm/cc. [8]

- (b) Describe different types of semi-permanent measures for controlling gully. [8]

4. (a) Design a parabolic shaped grassed waterway to carry a flow of 2.6 m<sup>3</sup>/s down a slope of 3%. The waterway has a good stand of grass and a velocity of 1.75m/s can be allowed. Take Manning's n = 0.04. [8]

- (b) Explain any three vegetative measures for conserving soil. [8]

5. Write short notes (any four) [4x4]

- (a) Degraded land rehabilitation
- (b) Recharge of groundwater
- (c) Causes and consequences of watershed deterioration
- (d) Small earth dams
- (e) Land capability classification

\*\*\*

Exam.	Back		
	Level	BE	Full Marks
Programme	BCE	Pass Marks	80
Year / Part	IV / I	Time	3 hrs.

**Subject:** - Soil Conservation and Watershed Management (Elective I) (EG735CE)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary. •

1. a) Calculate the minimum bottom width required for a dam of height 6.0m. Maximum depth of water to be impounded is 5.2 m and the face in contact with water is vertical. Top width of section is to be 1.5m. The density of dam material equals to 2.5 gm/cc and the coefficient of friction between dam and earth equals to 0.55. [8]
- b) Why Land Capability Classification is necessary? Which classes are recognized as not suitable for agricultural purposes? Describe briefly. [2+6]
2. a) Design a contour bund for a watershed having lateral slope of 27%. Daily maximum rainfall in the area is 90 mm. Assume top width of bund equal to 0.7 m and side slope 1.5:1(H:V). Also compute area lost due to bunding and earthwork for bunding, if the area under bunding is 5.5 ha. [4+4]
- b) Describe briefly all types of gully control structures with neat sketches. [8]
3. a) Design a grassed waterway of parabolic shape to carry a flow of  $3.5 \text{ m}^3/\text{s}$  down a slope of 2.5%. The waterway has a well-established sod of excellent quality ( $n=0.042$ ) and a velocity of 1.7 m/s can be permitted. [8]
- b) Design an earthen dam having fetch of wave equal to 20 Km. The reduced levels of river bed and full reservoir level are 848 m and 866 m respectively. Assume saturation gradient equal to 3:1, upstream dam slope 2.5:1 and downstream dam slope 3:1. [8]
4. a) Design a concrete chute spillway for a flood of  $3.5 \text{ m}^3/\text{s}$  and drop of 3.2 m. The channel width and depth in upstream are 3 m and 1m respectively. The ground slope at drop is 1.8:1 (H:V) [8]
- b) Describe types of bench terraces with neat sketches. [8]
5. a) Estimate soil loss from a 25 ha catchment having contour farming ( $P=0.5$ ) in 10 ha and strip cropping ( $P=0.3$ ) in 15 ha. Crops are maize and cabbage. Consider average Crop factor = 0.55, Rainfall factor = 1200 (tm/ha)\*(mm/ha) per year, soil factor = 0.35 t/ha/R and Topographic factor = 0.15 [4]
- b) Design a surplus weir for a catchment of 40 ha and intensity of rainfall equal to 1.2mm/min. Assume flow depth over the crest 45 cm and runoff coefficient equal to 0.45 [4]
- c) Briefly describe vegetative techniques for soil conservation with neat sketches. [8]
6. Write short notes on: (any four) [4×4]
  - a) Need and scope of soil and water conservation in Nepal
  - b) Format of watershed management plan
  - c) Types of soil erosion and land slides
  - d) Recharge and extraction of ground water
  - e) Sediment retention structure
  - f) Protection of developed infrastructures

**Subject: Soil Conservation and Watershed Management (Paper-I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.  
✓ Attempt any Five questions.  
✓ The figures in the margin indicate Full Marks.  
✓ Assume suitable data if necessary.

1. a) Define the term watershed management. Why do we need to conserve soil and watershed? [2+4]  
b) For a catchment, following are the values of USLE factors:  $LS = 1.25$ ,  $C = 0.35$ ,  $P = 1.0$ .

- i) For the following rainfall data in a particular season, estimate R factor. [6]

Duration (min)	10	12	15	20	30	5
Rainfall depth (mm)	2	4	7	15	5	1

Maximum 30 min. duration rainfall intensity = 50 mm/hr

- ii) Estimate K factor if the soil loss in that season was measured as 15 t/ha. [4]

2. a) Derive the formula for finding the height of contour bund. [8]  
b) In a hilly region, bench terracing (BT) is proposed for cultivation purpose. The general land slope is 25% and the average soil depth is about 0.9m. Compute the width and length of BT per ha. [8]

3. a) Explain, in brief, the different types of semi permanent structures to control gully erosion. [6]

- b) A drop spillway (straight) is to be constructed in the gully. The gully is 1.5m deep and 2.5m wide. The peak discharge through the gully is 1.5 m<sup>3</sup>/s. Compute the dimensions of the following components of the spillway: apron, cut off wall, side wall, wing wall and toe wall. [6]

4. a) Describe the concept of participatory approach to watershed management. [8]

- b) Design a grassed waterway with trapezoidal cross-section using following data. [8]

Peak discharge = 4 m<sup>3</sup>/s, Grade = 0.3%, Side slope = 2:1, Manning's roughness coefficient (n) = 0.04.

5. a) List the different vegetative measures for soil conservation and explain any four of them. [2+2.5×4]

- b) Compute the dimensions of settling basin to capture fine sand which settles at velocity equals to 0.007 m/s. The discharge entering the basin is 200 lps. [4]

6. Write short notes on: (any four) [4×4]

- a) Sheet erosion and rill erosion  
b) Objectives of watershed management  
c) Conservation pond  
d) Factors governing land levelling  
e) Trail improvement  
f) Advantages and limitations of graded bund

\*\*\*

*Handwritten signature*

Exam.	Regular	Back
Level	BE	Full Marks 80
Programme	BCE	Pass Marks 32
Year / Part	IV - I	Time 3 hrs.

**Subject:** - Soil Conservation and Watershed Management

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Why Land Capability Classification is necessary? Which classes are recognized as suitable for agricultural purposes? Describe briefly. [2+6]

b) Design a contour bund for a watershed having lateral slope of 22%. Daily maximum rainfall in the area is 11 cm. Assume top width of bund equal to 0.6 m and side slope 1:1. Also compute area lost due to bunding and earthwork for bunding, if the area under bunding is 5 ha. [4+4]

2. a) What are the causes and consequences of watershed deterioration? [3+3]

b) Design a grassed waterway of parabolic shape to carry a flow of  $3.2 \text{ m}^3/\text{s}$ , down a slope of 2.2%. The waterway has a well-established sod of excellent quality and a velocity of  $1.5 \text{ m/s}$  can be permitted. Assume  $n = 0.045$ .  $[T = 8; \gamma = 0.45]$  [8]

3. a) A masonry dam is 5.8 m high, 1.2 m wide at top and 4.8 m at bottom and has a vertical water face. The dam impounds water to a height of 4.8 m. Calculate the magnitude of the resultant force and its point of application with the base, when the reservoir is full and when it is empty. [8]

b) Design an earthen dam having fetch of wave equal to 30 km. The reduced levels of river bed and full reservoir level are 850 m and 868 m respectively. Assume saturation gradient equal to 3.5:1, upstream dam slope 2.5:1 and downstream dam slope 2:1. [8]

4. a) Describe engineering measures for erosion control in non - agricultural land. [8]

b) Design a concrete chute spillway for a flood of  $3 \text{ m}^3/\text{s}$  and drop of 3 m. The channel width and depth in upstream are 3m and 1m respectively. The ground slope at drop is 2:1 (H:V). [8]

5. a) Describe engineering measures adopted for erosion control in agricultural land. [8]

b) Briefly describe vegetative techniques for soil conservation with neat sketches. [8]

6. Write Short notes on any four of the following: [4X4]

- a) Need and Scope of Soil and Water Conservation in Nepal
- b) Bench Terrace
- c) Universal Soil Loss Equation
- d) Soil Texture and Structure
- e) Small Storage Structures
- f) Gabion Check Dam

\*\*\*

Exam.	Result		
Level	BE	Full Marks	88
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Rock Engineering (Elective I) (CE725)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary figures are attached herewith.
- ✓ Assume suitable data if necessary.

1. Define rock mass. What are common methods that are used in rock strength test? Define briefly. [2+6]
2. a) Write down the different stability problems due to stresses? [4]  
b) From the parameter given below. Find the magnitude of tangential stress at roof and wall of unlined pressure shaft. [8]  
Roof factor = 3.5  
Wall factor = 2.5  
Vertical stress = 12 Mpa  
 $\nu = 0.25$
3. Calculate the hydraulic conductivity of an array of parallel fractures in the direction parallel to the plane of a rock mass with a fracture frequency of one fracture per meter and with fracture apertures of 0.01 mm, the hydraulic conductivity is  $8.3 \times 10^{-10}$  m/s. [6+2]
4. What are the different stages of geological investigation for an underground structure? At what stage tunnel mapping is done? Explain the tunnel mapping with neat sketch. [12]
5. A rock mass classification system is required for assessing the suitability of different rock formations for storing compressed domestic gas in unlined rock caverns along the route of a main gas transmission line. Describe the rock parameters that you would use in a rock mass-rock engineering classification scheme for this objective. [12]
6. A 15 m high rock slope has been excavated at a face angle of  $65^\circ$  and is horizontal at the ground surface. The rock in which this cut has been made contains persistent bedding planes that dip at an angle of  $32^\circ$  in to the excavation. The 5.85 m deep tension crack is 4.5 m behind the crest, and is filled with water to the height of 4 m above the sliding surface. The strength parameters of the sliding surface are as follows: cohesion is 25kPa, friction angle is  $37^\circ$ , take the unit weight of rock as  $26 \text{ kN/m}^3$  and the unit weight of water as  $10 \text{ kN/m}^3$ . (a) Calculate the factor of safety of the slope for the conditions given above. (b) Determine the factors of safety if the tension crack were completely filled with water due to run off collecting on the crest of the slope. [6+6]
7. a) Describe briefly the rock support methods that are commonly used in underground structure. [4]  
b) What are high pressure tunnels and shafts? Why are these structures developed? [4]
8. Find mode of failure, direction of failure and angle of potential failure if slope face is  $65^\circ$  degree in the dip direction  $185^\circ$  degree from the three discontinuity set given below: [8]

Table: Discontinuity set

Joint set number	Dip / Dip direction
J <sub>1</sub> Foliation	45/95
J <sub>2</sub> Joint	75/240
J <sub>3</sub> Joint	20/190

\*\*\*

6N TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2068 Chaitra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Rock Engineering (Elective I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary figures are attached herewith.
- ✓ Assume suitable data if necessary.

1.a) Write the main goals of engineering geological investigation. List the activities which should be carried out during preconstruction and construction phase investigation. (8)

b) Calculate the water flow into a tunnel in lit/minute for following situations. (8)

Length of tunnel = 350 m

Specific permeability =  $10^{-15} \text{ m}^2$

Active head = 3 Mpa

Equivalent radius = 4.0 m

Distance between the length axis of excavation and ground water table = 20m

2.a) What is slope stability analysis? Briefly explain about the factors influencing the slope stability.

Discuss support methods which are commonly used in underground structures (10)

b) Estimate the magnitude of tangential stress at a roof and wall of an unlined pressure shaft using following input parameters

Roof factor = 3

Wall factor = 2.5

Vertical stress = 18 Mpa (6)

3. a) A 15 m diameter of underground chamber is to be excavated in medium inflow condition ( $J_w=0.5$ ).

The rock mass contains one joint sets ( $J_n=1.5$ ). The joint are undulating, rough, and unweathering and clean ( $J_r=2.5, J_a=1$ ). RQD is in the range of 70% .Estimate the rock support requirement for the given structure .Assuming stress reduction factor =15 and excavation support ratio =1.4 (10)

b) Explain stress surrounding circular underground opening. (6)

4.a) Describe the main engineering design procedure for underground opening. Also Briefly discuss design criteria for unlined high pressure tunnel and shaft (two rules of thumb). (10)

b) Explain the common method used for strength testing of rock mass (6)

5. Write short notes on: (4\*4)

- a) Q- method for rating of the rock mass quality
- b) Component of Virgin stresses
- c) Rock stress measurement
- d) Hydraulic conductivity and permeability of rock mass

6.a) The three discontinuity sets represents an area (ref. table 6.a) . Find mode of failure and angle of potential failure plane if angle of slope face is  $60^\circ$  in the dip direction of  $322^\circ$  (8)

**Table 6.a Discontinuity sets**

Joint set number	Dip/Dip direction	Joint spacing (cm)	Roughness
Foliation ( $J_1$ )	58/168	1-2	Planar to undulating
Joint ( $J_2$ )	52/342	18-40	undulating
Joint ( $J_3$ )	58/276	8-30	undulating

b) Draw the joint mapping of discontinuities (ref table 6.b ) in the hydropower project (8)

**Table 6. b Dip/dip direction**

35/300	55/07	15/290
40/025	70/075	78/340
75/29	15/330	65/08
20/165	25/280	22/285
30/280	12/280	83/09
60/100	70/08	75/140
85/07	75/200	75/190
80/190	30/290	80/340
85/200	20/330	20/320
75/060	68/070	78/060
65/240	25/290	78/200
15/290	82/160	22/280
78/090	30/290	80/110

\*\*\*

Exam.	Regular / Back		
	Level	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Rock Engineering (Elective I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions. Question No. 6 is compulsory.
- ✓ All questions carry equal marks.
- ✓ Necessary equal area net and tracing paper (A4 size) are attached herewith.
- ✓ Assume suitable data if necessary.

1. What is difference between shallow seated and deep seated opening for underground structures? Explain the design procedures for underground opening.
2. What are the main purposes of slope analysis? Write the factors which influence the slope stability. Discuss the methods which are used for rock slope stability analysis.
3. What are the various factors which may influence the stability of underground structures? Discuss the support methods which are today most commonly used in underground structures. Describe the approaches which are used for evaluation of rock support requirement and support design.
4. a. Describe the main Rock Engineering design consideration (Geological and Topographical) for unlined high pressure tunnel and shaft. Briefly discuss design criterion for high pressure tunnel and shaft.  
  
b. Draw the distribution of tangential stress surrounding the circular opening of a tunnel for following conditions and critically discuss the influence of rock stress anisotropy for above planned structure.

Major Principal Stress/ Minor Principal Stress = 16/12 (MPa)

Major Principal Stress/ Minor Principal Stress = 16/ 8 (MPa)

Major Principal Stress/ Minor Principal Stress = 16/4 (MPa)

5. Write short notes on:
  - a. Pre-Construction phase investigations for underground structures
  - b. Q-method for rating of the rock mass quality
  - c. Basic Flow Theory to estimate potential water leakage in tunnel
  - d. Methods for strength testing of rock and rock mass
6. a. The three discontinuity sets represents an area (ref. table 1). Find mode of failure and angle of potential failure plane if angle of slope face is 65 degrees in the dip direction of 185 degrees.

Table 1 Discontinuity sets

Joint set number	Dip/dip direction (Degree)
1 Foliation ( $J_1$ )	45/105
2 Joint ( $J_2$ )	70/235
3 Joint ( $J_3$ )	12/195

b. Plot the Joint Rosette with following attitude (in degrees) of discontinuities:

Dip/ Dip direction		
75, 190	55, 070	30, 290
80, 020	70, 072	80, 000
83, 100	15, 290	78, 090
30, 290	25, 025	85, 170
40, 060	75, 070	65, 017
82, 150	70, 075	80, 090
85, 100	78, 340	70, 090
30, 190	20, 290	65, 110
70, 165	75, 190	80, 205
27, 280	75, 200	82, 040
82, 260	15, 330	80, 210
85, 190	80, 190	30, 330
40, 300	50, 290	70, 080
65, 090	30, 290	70, 085
75, 165	80, 340	70, 065
25, 280	65, 200	12, 290
22, 285	20, 330	83, 160
10, 280	20, 320	73, 330
12, 280	75, 060	40, 270
80, 170	68, 070	45, 290
83, 090	78, 060	42, 280
80, 100	75, 240	
70, 080	25, 290	
10, 010	78, 200	
76, 140	15, 290	
65, 070	82, 160	
40, 100	22, 280	
	78, 190	

06D TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2070 Chaitra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Bio- Engineering (Elective I) (CE725)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What is the present status of erosion from mountainous area of Nepal? Write down the problems encountered in hill slope and engineering functions to be performed to address them. [8]
2. What do you mean by landslide mapping? Enlist the steps for preliminary landslide mapping in site. [8]
3. Write down the field method for slope stability based on orientation of rock fractures. [8]
4. What is a plant community? Write down the role of plant community in the establishment of plants at the site. [8]
5. What are the roles of vegetation in Bio-engineer? Explain Hydrological function of plant. [8]
6. How does the moisture availability affect the selection of plant species? Write down the considerations to be made for maintaining the plant community. [8]
7. What are the vegetative stabilization techniques? Explain suitable construction methods of vertical line of grass plantation. Mention its limitation. [8]
8. Many retaining walls have been failed on the road side. What are its major causes? Write down the general guideline for the selection of type of retaining structures. [8]
9. What is the process of general assessment of the site? Write down some examples of solving the problem of slope failure on the basis of general assessment. Mention the activities of the Bioengineering works that are dependent on the season. [2+2+4]
10. What are the advantages of small nursery? Write down the factors that should be incorporates while selecting nursery site. [8]

\*\*\*

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject:** - Bio- Engineering (Elective I) (CE725)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What is the present status of erosion from mountainous area of Nepal? Write down the problems encountered in hill slope and engineering functions to be performed to address them. [8]
2. What do you mean by landslide mapping? Enlist the steps for preliminary landslide mapping in site. [8]
3. Write down the field method for slope stability based on orientation of rock fractures. [8]
4. What is a plant community? Write down the role of plant community in the establishment of plants at the site. [8]
5. What are the roles of vegetation in Bio-engineer? Explain Hydrological function of plant. [8]
6. How does the moisture availability affect the selection of plant species? Write down the considerations to be made for maintaining the plant community. [8]
7. What are the vegetative stabilization techniques? Explain suitable construction methods of vertical line of grass plantation. Mention its limitation. [8]
8. Many retaining walls have been failed on the road side. What are its major causes? Write down the general guideline for the selection of type of retaining structures. [8]
9. What is the process of general assessment of the site? Write down some examples of solving the problem of solpe failure on the basis of general assessment. Mention the activities of the Bioengineering works that are dependent on the season. [2+2+4]
10. What are the advantages of small nursery? Write down the factors that should be incorporates while selecting nursery site. [8]

\*\*\*

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Bio-Engineering (CE72504) (Elective I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ All questions carry equal marks.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Define Bio-Engineering. Illustrate the engineering function of plants.
2. What is weathering? Differentiate the slope materials based on the weathering grade.
3. How is a landside different from mass wasting? Mention the repair priorities of the landslide based on its history.
4. What is plant community? Why is it maintained in Bio-Engineering?
5. A site has been treated with tree plantation with root characteristics given as below. Estimate the increase in the shear strength of the slope material by perpendicular root area method if the angle of internal friction of the slope material is  $30^\circ$  and the area of root coverage is  $4\text{m}^2$ .

Diameter of roots, mm	No. of roots	Tensile strength of root fiber, MPa	Average Angle of shear distortion in the shear zone, $^\circ$
10	62	47	18
13	37	41	35
17	29	37	25
21	8	32	37

6. How can you select appropriate plant species for bio-engineering works in a particular area?
7. Where can the diagonal lines of grass plantation be implemented as a vegetative system? Write down its implementation procedure.
8. Define Small Scale Civil Engineering Structure. Explain particular features of checkdam that should be incorporated in its construction.
9. Explain the importance of bio-engineering programming. Write down the physical requirements of seed bed.
10. You are planning to establish a Nursery. Prepare a checklist of materials, tools and equipments to be purchased for this purpose. Draw a typical section of a bamboo bed in a nursery and mention its genera requirements.

\*\*\*

Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject:** - Bio-Engineering (*Elective I*) (EL102CE)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ **All** questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. a. What do you understand by geomorphology? Write down different morphological characteristics of slopes that play an important role in the forecasting of potentiality of landslides in the slopes.  
b. Write down the characteristics of a slope that lead to the plane failure. Describe it with an example.
2. a. What are the basic requirements of plant? Write down the minerals that are lack in acidic and alkaline soil. Write down the mineralization process.  
b. How does the soil structure affect the plant growth? Write down the methods of improving the soil fertility.
3. a. What are the site requirements for the implementation of live check dam as a bioengineering system? Write down the method of operation, implementation procedure and limitation of live check dam.  
b. What is a bioengineering nursery? Write down the physical features of different components of a nursery that should be considered as design requirements.
4. a. What are the hydrological roles of vegetation on the slope? How can the loss of soil be affected with the percentage canopy cover of plant, height of the plant and size of the leaves?  
b. Why do the bioengineers accept to use compost in bioengineering sites? Write down the preparation procedure of compost
5. a. what is bioengineering calendar? How can it be prepared and maintained in the process of implementation of bioengineering activities?  
b. What is bamboo crib wall? Write down the site requirements, procedure and problems for the implementation of a bamboo crib wall.
6. Write short notes on (any four):
  - a. Role of plant roots in the stability of slopes.
  - b. Seed collection for bioengineering implementation
  - c. Role of soil water relationship in bioengineering
  - d. Bolster as a small-scale civil engineering system
  - e. Combination of civil and bioengineering systems

Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Bio-Engineering (Elective I) (CE72504)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- 1 Define Bio Engineering. Write down the application and scope of bioengineering in the civil Engineering field. ? [8]
- 2 What are major metamorphic rocks available in Nepal Himalaya? Mention the potentiality of slope failure on the basis of lithological factor of rock. [8]
- 3 What is a landslide? How can it be mapped in the field? Write down its procedure. [8]
- 4 How can the plants be classified based on its root structure? Write down the basic characteristics of a plant community. [8]
- 5 Calculate the amount of increased shear strength of a Bioengineered site which composes of the material with the angle of internal friction of  $35^\circ$ . The roots were observed in a cross section area of five  $m^2$ . The details of the roots are as follows: [8]

Diameter of roots, mm	No. of roots	Tensile strength of root fiber, MPa	Average Angle of shear distortion in the shear zone, $^\circ$
12	40	52	12
15	32	43	18
18	24	32	22
20	15	22	24

- 6 What are the factors that lead to distribution of plant species in Nepal? Write down the selection procedure of plant species based on the drought factor of the slope. [8]
- 7 What is palisade? Write down the process of site preparation, method of operation, limitation, materials and site requirements and function of Palisade construction as a bioengineering system. [8]
- 8 How can the sizes of a retaining wall fixed for the slope stabilization work? Write down the factors to be considered in the implementation of Retaining wall. [8]
- 9 What are the techniques that can be taken in to account for the general assessment of the site for its further treatment? Give some examples of site treatment after the general assessment of the site. Prepare a annual program for the implementation of bioengineering work with the following activities: [2+2+4]  
Nursery establishment, purchase of land for nursery, seed collection, transport of seedling to the site, grass plantation, palisade construction, breast wall construction, slip clearance
- 10 What is a nursery? Draw a typical section of a grass bed and mention its general requirements. [8]

Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

*Subject: - Bio-Engineering (Elective I)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. What is the scenario of soil erosion in Nepal? Write down the advantages and limitations of bioengineering as a tool for slope stabilization.
2. How can the effectiveness of the root be evaluated based on slope material type? Mention them. Write down the different causes and mechanism of failure in different types of slope materials.
3. How can the seriousness of the failed site be evaluated? Write down the factors that lead to finalization of priority to repair the site.
4. What are the different types of plants that are used in bioengineering? Write down the basic requirements of the plant. Mention, how the compost serves the soil to improve its quality.
5. Calculate the amount of increased shear strength of a Bioengineered site which composes of the material with the angle of internal friction of  $30^0$ . The roots were observed in a cross section area of eight  $m^2$ . The details of the roots are as follows:

Diameter of roots, mm	No. of roots	Tensile strength of root fiber, MPa	Average Angle of shear distortion in the shear zone, $^0$
8	15	60	8
12	20	55	12
18	25	45	16
24	30	35	24

6. How can the plant types be divided based on the climatic zones? Write down the process of final selection of plant type.
7. What are the site requirements for the brushlayering? Write down the implementation procedure, materials required for the implementation and limitations of Brushlayering.
8. Why are the catch drains discarded in the bioengineering implementations? Write down the construction procedure of wire bolsters at the bioengineering site.
9. What are the technical characteristics of the site that are incorporated in the preparation of the guideline for the selection of optimal technique? Write down the hurdles to be faced in bioengineering projects because of the fiscal year system of Nepal. Write your suggestions to solve these problems.
10. What are the major components of a nursery? Draw a typical cross section of a seed bed and write its general requirements.

6B TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2068 Chaitra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

***Subject: - Bio-Engineering (Elective I)***

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ **All** questions carry equal marks.
- ✓ Assume suitable data if necessary.

- 1 a) What is the scenario of soil loss from Nepalese territory? Mention the problems on slopes and write down the engineering functions to be performed to solve these problems.  
b) How can the slopes be classified depending upon its impact on the stability? Mention them.
- 2 a) Write down the diagnostic properties of any 4 sedimentary rocks that are available in Nepal Himalaya? Write down the causes and mechanism of slope failure with debris, soft rock, alternative band of hard and soft rock and hard rocks.  
b) What is the role of weathering on the stability of slope? Write down the types of the slopes depending upon the weathering grade of the rock.
- 3 a) What is the hydraulic role of vegetation? How can it be proved that vegetation performs the hydraulic role? Illustrate it with examples.  
b) How do the slope types play the role in the selection of plant species? Write down selection criteria of plants based on the degree of community participation.
- 4 a) What are the site conditions where the horizontal line of grass plantation can be implemented? Write down the method of implementation of Brush layering on the slope.  
b) What are the problems encountered in the drainage systems in bioengineering? Write down the procedure of constructing a French drain on a landslide zone.
- 5 a) What are the criteria for the selection of optimal techniques in bioengineering works? Write down the techniques of using the general assessment criteria for the selection of bioengineering techniques.  
b) What are the general requirements of a nursery? Draw a neat sketch of a seed bed.
6. Write short notes on:
  - a) Conditions leading to wedge failure
  - b) Fascine construction
  - c) Seasonal programming
  - d) Effect of logging from the slope

\*\*\*

TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
Pulchowk Campus  
Department of Civil Engineering  
Internal assessment examination  
2065

Examination	Regular/Back	Regular
Level: B.E.	Full marks	20
Programme: Civil	Pass marks	8
Year: IV	Time	2 Hrs.

Subject: Bio- Engineering

Candidates are required to give their answers in their own words as far as practicable.  
Attempt **any 5(five)** questions.  
All questions carry **equal** marks.

Q.No.1.

- A. What are the problems related with slope instability? Mention them and list out the engineering functions to be performed for their solution.
- B. How can the seriousness of the instability of slope be assessed depending on the lithological factor of rock? Describe the procedure of prioritization for landslide repair works.

Q.No.2

- A. What is a landslide? Write down the steps of landslide mapping technique.
- B. Define plant community. Write down its importance in the selection of plant species.

Q.No.3.

- A. What is a check dam constructed for? Mention, how they should be spaced far.
- B. It is necessary to cut a slope with sandy material to a slope angle of 65°. What small-scale civil engineering system can be incorporated with the random pattern of grass plantation at the site? Write down the limitation of that system.

Q.No.4.

- A. What do you mean by the interaction between civil and vegetative systems? Mention the factors to be considered for the combination of civil and vegetative systems.
- B. What are the bases for selection of optimal Bioengineering techniques? Give an example.

Q.No.5

- A. What is a small scale civil engineering system? Write down the practical features that should be considered while designing and constructing the retaining structures.
- B. What is Brush layering? Write down the materials required, construction procedure of its implementation and the suitable sites.

Q.No.6

- Write short notes on:
1. Basic requirement of plants
  2. Weathering grade of rock
  3. Causes and mechanism of slope failure
  4. Maintenance of bioengineering system

02D TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2065 Shrawan

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Bio-Engineering (Elective I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ **All** questions carry equal marks.
- ✓ Assume suitable data if necessary.

Q.No.1

- A. What are the features of different land units of Nepal Himalaya? How do these land units express the stability of the slope? Illustrate it with sketches.
- B. How do you decide whether the slope failure occurs by wedge failure mechanism? Describe it with an example.

Q. No. 2

- A. What is mineralization process? Write down the importance of compost in the enhancement of soil quality. What is the significance of acidic and alkaline soil on the soil quality?
- B. What are the scientific justifications to prove that vegetation performs the hydraulic role? How do the size of canopy, leaves and the height of vegetation affect the hydrological role of the vegetation?

Q.No.3

- A. What are the site requirements, materials and method of implementation of wire bolsters as a small-scale civil engineering system? Write down the hazard that is expected after the bolster construction.
- B. What is the difference in the factor of safety of a slope with and without the vegetation? Write down the circumstances that lead the change of the factor of safety of the slope with and without vegetation.

Q.No.4

- A. What are the different methods of bamboo propagation? Write down the features of a bamboo bed in the nursery.
- B. Write down the site requirements, procedure and problems for the implementation of live check dam as a bioengineering system. What can be achieved after its construction?

Q.No.5

- A. What are different activities that should be carried out to achieve the required performance of bioengineering systems in the long run? What is difference between the maintenance of bioengineering works in comparison with other civil engineering works?
- B. How can the bioengineering plant species be selected based on the drought factor of the site? Explain.

Q.No.6 Write short notes on (any four):

- A. Advantages of small nurseries
- B. Scope and limitation of bioengineering
- C. Role of soil water relationship in bioengineering
- D. Bamboo crib wall in bioengineering work
- E. Bioengineering programming work

Sutra

TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
Internal assessment examination  
2063

Examination	Regular/Back	Regular
Level: B.E.	Full marks	20
Programme: Civil	Pass marks	8
Year: IV	Time	2 Hrs.

Subject: Bio- Engineering

Candidates are required to give their answers in their own words as far as practicable.

Attempt **any 5(five)** questions.

All questions carry **equal** marks.

Q.No.1

- ✓ A. Write down the advantages and limitations of Bioengineering. How can you convince the traditionally trained engineer about the relevancy of bioengineering? Describe it.
- B. What are the different types of slopes based on the impact of bioengineering works in its repair activities? List out the factors that should be considered for the prioritization of repair works.

Q.No.2

- A. What are the different types of slope material depending upon the weathering grade? Write down the factors that lead to failure of the slope.
- B. What are the characteristics of rock that should be incorporated for the analysis of slope stability in the field? Mention the role of mineral type in the slope stability.

Q.No.3

- ✓ A. What is a live check dam? Explain the function, method of operation, site requirement and limitation of palisade construction.
- B. How is the site prepared for the implementation of grass planting in horizontal pattern? Write down the hazards of horizontal line of grass plantation.

Q.No.4

- A. What is the jute net used for? Write down the practical features that should be considered while implementing the jute net in the site.
- B. What are the different drainage systems in bioengineering? Explain how surface water is drained out from the landslide zone. Can the catch drain do it? Why?

Q.No.5

- What are the criteria for the selection of optimal techniques in bioengineering works? Explain how plant species is selected based on the draught factor.
- B. What system do you prefer for the repair and maintenance of landslide area? why? Illustrate it with examples.

Q.No.6

Write short notes on:

1. Stability analysis based on the orientation of rock fractures
2. Selection of plant species based on morphological characteristics
3. Stability analysis of slope incorporating the effect of vegetation
4. Method of bamboo crib wall construction

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Solid Waste Management (Elective I) (CE725)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) What are the basic information needed for ISWM design? Give the history of development of solid waste management in the context of Nepalese society. [8]
- b) What are the factors affecting solid waste generation in Nepal. What is biological conversion of solid waste? [8]
2. a) What is landfill? How many types of landfills are there for solid waste management? Describe in brief the sanitary landfills and its uses in the context of Nepal. [1+3+4]

**OR**

- What is the area required for land filling of Janakpur city if the per capita waste generation is 240 g and average projected population is 5,00,000.00 for a decade. Calculate the area required if 20% of the waste produced per capita is added for commercial and other wastes and 80% of the waste is expected to reach the land filled site. The density of waste after compaction in the land fill is expected to be 500 kg/m<sup>3</sup>. It is estimated that there will be 5 cells in 1 lift of 5 m including daily cover height of 15 cm and intermittent cover of 30 cm. The landfill allows maximum of 5 lifts. The landfill site is run for 6 days in a week. [8]
- b) Determine the ratio of waste to cover material (volume basis) as a function of the initial compacted specific weight for a solid waste stream of 70 tones per day to be placed in 10 ft with a cell width of 15 ft. The slope of the working faces is 3:1. Assume that the waste is compacted initially to an average specific weight of 600, 800 and 1000 lb/yd<sup>3</sup>. The daily cover thickness is 6 inch. [8]
  3. a) Describe different types of collection services used. What is on site management? [4]
  - b) Composition of 100 kg MSW sample of community given bellow and estimate the energy content and chemical formula for MSW with and without sulfur. [12]

Component	Wet mass kg	Moisture Content %	Percent by mass dry basis					
			Carbon	Hydrogen	Oxygen	Nitrogen	Sulfur	Ash
Food wastes	30.0	70.0	48.0	6.4	37.60	2.6	0.4	5.0
Paper	15.0	6.0	43.5	6.0	44.00	0.3	0.2	6.0
Cardboard	5.0	5.0	44.0	5.9	44.60	0.3	0.2	5.0
Plastics	8.0	2.0	60.0	7.2	22.80	0.0	0	10.0
Textiles	5.0	10.0	55.0	6.6	31.20	4.6	0.15	2.5
Rubber	10.0	2.0	78.0	10.0	0.00	2.0	0	10.0
Leather	7.0	10.0	60.0	8.0	11.60	10.0	0.4	10.0
Yard Wastes	7.0	60.0	47.8	6.0	38.00	3.4	0.3	4.5
Wood	6.0	20.0	49.5	6.0	42.70	0.2	0.1	1.5
Tin cans	7.0							

4. a) What are the different design considerations for the materials recovery facilities? [6]

b) Determine the number of container that can be emptied per day using the hauled container collection system for Balaju Industrial District Kathmandu. The data available for analysis are as follow: [10]

Time to drive from garage to first container ( $t_1$ ) = 20 min

Time to drive from last container to garage ( $t_2$ ) = 25 min

Total time required to pickup loaded container and unload empty container = 0.4 hr/trip

Average time required to drive between container = 8 min

One way distance to disposal site = 25 Km (speed limit: 40 km/hr)

$S = 0.12$  hr/trip,  $a = 0.16$  h/trip,  $b = 0.011$ ,  $W = 0.2$

Length of work day = 8 h/day

5. Write short notes on: [4×4]

a) **Compositing**

b) **Resource recovery**

c) **Solid waste management practice in Nepal**

d) **Transfer and transport of MSW**

\*\*\*

Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Solid Waste Management (Elective I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary Typical Properties of MSW DATA table attached herewith.
- ✓ Assume suitable data if necessary.

1) a) What is solid waste management and elaborate its development phases in Nepal? Discuss the waste management issues in reference of ISWM. [8]

b) As a planner; where and when transfer stations should proposed? Explain. What are the considerations to be fulfilled in the construction of transfer station? [8]

2) a) What is collection service and collection system? The chemical formula of propylene is  $\text{CH}_3\text{CHCH}_2$ . What would be the heat value of propylene? [8]

b) Estimate the theoretical amount of air required to oxidize completely One tone of waste having the composition  $\text{C}_{60}\text{H}_{120}\text{O}_{30}\text{N}_3$ . [8]

3) a) Poor management of solid wastes has consequence of health impacts; how you evaluate the practices of organic waste recycling in Nepal, regarding the above issues, explain. [6]

b) A typical distribution of waste component rapid biodegradable portion of MSW generated by a residential community is as follows: [10]

Determine the:

- i. Overall moisture content
- i. Overall density of waste sample
- i. Approximate chemical formula

Component% by weight

Food waste	60
Paper	10
Cardboard	4
Yard waste	6

4) a) What is the importance of waste generation rate? What are the factors affecting waste generation? Explain different method of determining waste generation rate. [6]

b) A total of 11 apartment complexes and commercial establishment have entered into a contact with a solid waste collection firms to collect their solid wastes. The discarded volume of solid wastes to be collected is 96 m<sup>3</sup> per collection day. Determine the number of trips required on collection day, (optimize trip if possible), the size of collection vehicle and the size of the container to be provided. Assume following assumption and for simplicity 11 sources contributes the same quantity of solid wastes. Number of containers emptied per trip = 11 containers per trip; container number in each location =1, Compaction ratio =2. 5, Time for driving between container = 0.09 h, Time from garage to first container = 20 minutes; Time from the last container to garage = 25 minutes, at site time= 0.1 hours, Loading and unloading time = 0.1 hours.; landfill site is 30 km away, off route factor=0. 15, working hour= 8h, vehicle speed 56 km/her and haul time constant a= 0.034 hours/trip, b=0. 018 hour/km [10]

5) a) What are different component involved in planning, designing and operation of landfill? What are the criteria for landfill site selection. [8]

b) Compute the total volume of gas of a landfill that generate in first three years where the 80 tons of waste deposit daily and the gas generation rate from RB and SB is 0.92 m<sup>3</sup> / kg and 1.16 m<sup>3</sup> / kg. Gas generation starts after one year of deposition. [8]

6) Write short notes on any four: [4X2]

- a) Final Cover Configuration Of Landfill Site.
- b) Vermi -Composting
- c) On Site Management
- d) Legislation Provision Of SWM In Nepal
- e) Material Recovery Facility (MRF)

## Typical properties of residential MSW

Component of waste	Specific Weight (kg/m <sup>3</sup> )		Moisture Content (% by weight)		Energy content (kJ/kg)		Typical data on the ultimate analysis of the combustible components in residential MSW					
							Percentage by weight (dry basis)					
	Range	Typical	Range	Typical	Range	Typical	Carbon	Hydrogen	Oxygen	Nitrogen	Sulphur	Ash
Food waste	130-480	290	50-80	70	3490-6980	4650	48	6.4	37.6	2.6	0.4	5
Paper	40-130	90	4-10	6	11630-18610	16750	43.5	6	44	0.3	0.2	6
Card board	40-80	50	4-8	5	13955-17445	16280	44	5.9	44.6	0.3	0.2	5
Plastics	40-130	65	1-4	2	27910-37210	32565	60	7.2	22.8	—	—	10
Textiles	40-100	65	6-15	10	15120-18610	17445	55	6.6	31.2	4.6	0.15	2.5
Rubber	100-200	130	1-4	2	20930-27910	23260	78	10	—	2	—	10
Leather	100-260	160	8-12	10	15120-19770	17445	60	8	11.6	10	0.4	10
Yard waste	60-225	100	30-80	60	2325-18605	6510	47.8	6	38	3.4	0.3	4.5
Wood	130-320	240	15-40	20	17445-19770	18610	49.5	6	42.7	0.2	0.1	1.5
Glass	160-480	195	1-4	2	115-230	140	0.5	0.1	0.4	0.1	—	98.9
Tin cans	50-160	90	2-4	3	230-1160	700	—	—	—	—	—	—
Aluminum	65-240	160	2-4	2	—	—	—	—	—	—	—	—
Other metals	130-1150	320	2-4	3	230-1160	700	4.5	0.6	4.3	0.1	—	90.5
Dirt, ashes	320-1000	480	6-12	8	2325-11630	6980	26.3	3	2	0.5	0.2	68

## Typical proximate analysis and energy data for materials found in residential, commercial and industrial solid wastes.

Type of waste	Proximate analysis % by weight				Energy content (kJ/kg)		
	Moisture	Volatile matter	Fixed carbon	Non-combustible	As collected	Dry	Dry ash-free
Food waste	70	21.4	3.6	5	4180	13916	16700
Paper	10.2	75.9	8.4	5.4	15815	19734	18738
Card board	5.2	77.5	12.3	5	16380	17278	18240
Plastics	0.2	95.8	2	2	32799	33471	37272
Textiles	10	66	17.5	6.5	18515	20572	22857
Rubber	1.2	83.9	4.9	9.9	25330	25637	28494
Leather	10	68.5	12.5	9	17445	18701	20892
Yard waste	60	30	9.5	0.5	6050	15126	15317
Wood	20	68.1	11.3	0.6	15445	19343	19499
Glass and mineral	2	—	—	96-99	195	200	140
Metal, tin, cans	5	—	—	94-99	700	742	737
Metal, ferrous	2	—	—	96-99	—	—	—
Metal, non ferrous	2	—	—	94-99	—	—	—

020 TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2069 Bhadra

Exam.	Regular / Back •		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Solid Waste Management (EG785CE) (Elective II)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary tables are attached herewith.
- ✓ Assume suitable data if necessary.

1. a) Discuss the development phases of solid waste management. What do you understand by ISWM? 8  
Discus the functional elements of ISWM.
- b) What is solid waste? What are various methods of collecting solid waste? Describe any one of them. 8
2. a) As a planner; where and when transfer stations should be proposed? Explain. What are the considerations 8  
to be fulfilled in the construction of transfer station?
- b) Estimate the theoretical amount of air required to oxidize completely One tonne of waste having the 8  
composition  $C_{60}H_{120}O_{30}N_3$ .
3. a) What are different component involved in planning, designing and operation of landfill? What are the 8  
criteria for land fill site selection?
- b) The authorities are planning to purchase a compaction truck for solid waste disposal for a mechanically 8  
loaded stationary container system. What is the size of compactor truck if the container size is  $0.6 m^3$ ?  
Following information are available :  

Container utilization factor = 0.7

Average container number in each location = 12

Compaction ratio = 2

Time from garage to first container = 20minutes

Trips per day to disposal site = 2

Of route factor = 0.15

At site time = 0.1 hr

Take haul time constant  $a = 0.016 \text{ hr/trip}$ ;  $b = 0.011 \text{ hr/km}$

Container unloading time = 0.05 hr/ container

Driving time between container = 0.1hr/ location

One way haul distance = 29 km

Speed limit = 88 km/hr

Time from last container to garage = 15 minutes

Working hours = 8 hr
4. a) Describe in detail about the different phases of generation of landfill gases in the landfill site. 10
- b) The chemical formula of PVC is  $C_2HCl$ . What would be the approximate energy content of PVC? 6
5. a) What is MRF? Discuss the different recovery processes adopted in community. 8
- b) LDC countries facing poor management of solid wastes has consequence of health impacts ; how do you 8  
evaluate the practices of organic waste recycling in Nepal, regarding the above issues? Explain.
6. Write short notes on any four: 4\*4
 

a) Vermicomposting

b) Legislation provision of SWM in Nepal

c) Resources recovery

d) On site management

e) landfill bottom liner configuration

\*\*\*

# Typical properties of residential MSW

Component of waste	Specific Weight (kg/m <sup>3</sup> )		Moisture Content (% by weight)		Energy content (kJ/kg)		Typical data on the ultimate analysis of the combustible components in residential MSW					
							Percentage by weight (dry basis)					
	Range	Typical	Range	Typical	Range	Typical	Carbon	Hydrogen	Oxygen	Nitrogen	Sulphur	Ash
Food waste	130-480	290	50-80	70	3490-6980	4650	48	6.4	37.6	2.6	0.4	5
Paper	40-130	90	4-10	6	11630-18610	16750	43.5	6	44	0.3	0.2	6
Card board	40-80	50	4-8	5	13955-17445	16280	44	5.9	44.6	0.3	0.2	5
Plastics	40-130	65	1-4	2	27910-37210	32565	60	7.2	22.8	—	—	10
Textiles	40-100	65	6-15	10	15120-18610	17445	55	6.8	31.2	4.6	0.15	2.5
Rubber	100-200	130	1-4	2	20930-27910	23260	78	10	—	2	—	10
Leather	100-260	160	8-12	10	15120-19770	17445	60	8	11.6	10	0.4	10
Yard waste	60-225	100	30-80	60	2325-18605	6510	47.8	6	38	3.4	0.3	4.5
Wood	130-320	240	15-40	20	17445-19770	18610	49.5	6	42.7	0.2	0.1	1.5
Glass	160-480	195	1-4	2	115-230	140	0.5	0.1	0.4	0.1	—	98.9
Tin cans	50-160	90	2-4	3	230-1160	700	—	—	—	—	—	—
Aluminum	65-240	160	2-4	2	—	—	—	—	—	—	—	—
Other metals	130-1150	320	2-4	3	230-1160	700	4.5	0.6	4.3	0.1	—	90.5
Dirt, ashes	320-1000	480	6-12	8	2325-11630	6980	26.3	3	2	0.5	0.2	68

## Typical proximate analysis and energy data for materials found in residential, commercial and industrial solid wastes

Type of waste	Proximate analysis % by weight				Energy content (kJ/kg)		
	Moisture	Volatile matter	Fixed carbon	Non-combustible	As collected	Dry	Dry ash-free
Food waste	70	21.4	3.6	5	4180	13916	16700
Paper	10.2	75.9	8.4	5.4	15815	19734	18738
Card board	5.2	77.5	12.3	5	16380	17278	18240
Plastics	0.2	95.8	2	2	32799	33471	37272
Textiles	10	66	17.5	6.5	18515	20572	22857
Rubber	1.2	83.9	14.9	9.9	25330	25637	28494
Leather	10	68.5	12.5	9	17445	18701	20892
Yard waste	60	30	9.5	0.5	6050	15126	15317
Wood	20	68.1	11.3	0.6	15445	19343	19499
Glass and mineral	2	—	—	96-99	195	200	140
Metal, tin, cans	5	—	—	94-99	700	742	737
Metal, ferrous	2	—	—	96-99	—	—	—
Metal, non ferrous	2	—	—	94-99	—	—	—

Exam.	Regular / Back •		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject:** - Solid Waste Management (EG785CE) (Elective II)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary tables are attached herewith.
- ✓ Assume suitable data if necessary.

1. a) Discuss the development phases of solid waste management. What do you understand by ISWM? 8  
Discus the functional elements of ISWM.
- b) What is solid waste? What are various methods of collecting solid waste? Describe any one of them. 8
2. a) As a planner; where and when transfer stations should be proposed? Explain. What are the considerations 8  
to be fulfilled in the construction of transfer station?
- b) Estimate the theoretical amount of air required to oxidize completely One tonne of waste having the 8  
composition  $C_{60}H_{120}O_{30}N_3$ .
3. a) What are different component involved in planning, designing and operation of landfill? What are the 8  
criteria for land fill site selection?
- b) The authorities are planning to purchase a compaction truck for solid waste disposal for a mechanically 8  
loaded stationary container system. What is the size of compactor truck if the container size is  $0.6 m^3$ ?  
Following information are available :  

Container utilization factor = 0.7

Average container number in each location = 12

Compaction ratio = 2

Time from garage to first container = 20minutes

Trips per day to disposal site = 2

Of route factor = 0.15

At site time = 0.1 hr

Take haul time constant  $a = 0.016 \text{ hr/trip}$ ;  $b = 0.01 \text{ hr/km}$

Container unloading time = 0.05 hr/ container

Driving time between container = 0.1hr/ location

One way haul distance = 29 km

Speed limit = 88 km/hr

Time from last container to garage = 15 minutes

Working hours = 8 hr
4. a) Describe in detail about the different phases of generation of landfill gases in the landfill site. 10
- b) The chemical formula of PVC is  $C_2HCl$ . What would be the approximate energy content of PVC? 6
5. a) What is MRF? Discuss the different recovery processes adopted in community. 8
- b) LDC countries facing poor management of solid wastes has consequence of health impacts ; how do you 8  
evaluate the practices of organic waste recycling in Nepal, regarding the above issues? Explain.
6. Write short notes on any four: 4\*4
 

a) Vermicomposting

b) Legislation provision of SWM in Nepal

c) Resources recovery

d) On site management

e) landfill bottom liner configuration

## Typical properties of residential MSW

Component of waste	Specific Weight (kg/m <sup>3</sup> )		Moisture Content (% by weight)		Energy content (kJ/kg)		Typical data on the ultimate analysis of the combustible components in residential MSW					
							Percentage by weight (dry basis)					
	Range	Typical	Range	Typical	Range	Typical	Carbon	Hydrogen	Oxygen	Nitrogen	Sulphur	Ash
Food waste	130-480	290	50-80	70	3490-6980	4650	48	6.4	37.6	2.6	0.4	5
Paper	40-130	90	4-10	6	11630-18610	16750	43.5	6	44	0.3	0.2	6
Card board	40-80	50	4-8	5	13955-17445	16280	44	5.9	44.6	0.3	0.2	5
Plastics	40-130	65	1-4	2	27910-37210	32565	60	7.2	22.8	—	—	10
Textiles	40-100	65	6-15	10	15120-18610	17445	55	6.8	31.2	4.6	0.15	2.5
Rubber	100-200	130	1-4	2	20930-27910	23260	78	10	—	2	—	10
Leather	100-260	160	8-12	10	15120-19770	17445	60	8	11.6	10	0.4	10
Yard waste	60-225	100	30-80	60	2325-18605	6510	47.8	6	38	3.4	0.3	4.5
Wood	130-320	240	15-40	20	17445-19770	18610	49.5	6	42.7	0.2	0.1	1.5
Glass	160-480	195	1-4	2	115-230	140	0.5	0.1	0.4	0.1	—	98.9
Tin cans	50-160	90	2-4	3	230-1160	700	—	—	—	—	—	—
Aluminum	65-240	160	2-4	2	—	—	—	—	—	—	—	—
Other metals	130-1150	320	2-4	3	230-1160	700	4.5	0.6	4.3	0.1	—	90.5
Dirt, ashes	320-1000	480	6-12	8	2325-11630	6980	26.3	3	2	0.5	0.2	68

## Typical proximate analysis and energy data for materials found in residential, commercial and industrial solid wastes.

Type of waste	Proximate analysis % by weight				Energy content (kJ/kg)		
	Moisture	Volatile matter	Fixed carbon	Non-combustible	As collected	Dry	Dry ash-free
Food waste	70	21.4	3.6	5	4180	13916	16700
Paper	10.2	75.9	3.4	5.4	15815	19734	18738
Card board	5.2	77.5	12.3	5	16380	17278	18240
Plastics	0.2	95.8	2	2	32799	33471	37272
Textiles	10	66	17.5	6.5	18515	20572	22857
Rubber	1.2	83.9	14.9	9.9	25330	25637	28494
Leather	10	68.5	12.5	9	17445	18701	20892
Yard waste	60	30	9.5	0.5	6050	15126	15317
Wood	20	68.1	11.3	0.6	15445	19343	19499
Glass and mineral	2	—	—	96-99	195	200	140
Metal, tin, cans	5	—	—	94-99	700	742	737
Metal, ferrous	2	—	—	96-99	—	—	—
Metal, non ferrous	2	—	—	94-99	—	—	—

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Solid Waste Management (Elective II)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Necessary Typical Properties of MSW Data are attached herewith.
- ✓ Assume suitable data if necessary.

1. a) What is solid waste? Describe the factors governing the solid waste generation rate in a municipality area. [8]
- b) Discuss the development phases of solid waste management in Nepal. Sketch the various stages of waste management hierarchy. [8]
2. a) Where and when transfer stations should be proposed? Explain. What are the conditions to be fulfilled in the construction of transfer station? Explain. [8]
- b) A typical distribution of waste component of MSW generated from a residential community is as follows: [8]

Components	Wet weight by%
Food waste	59
Paper	13
Plastic	6
Fabric	8
Wood	10
Glass	1
Dirt	3
Total	100

Determine the approximate chemical formula.

3. a) Elaborate different types of waste collection services. How does these collection services differ from the collection system? Explain. [8]
- b) The theoretical landfill gas generation from readily biodegradable (RB) and slowly biodegradable (SB) fraction of the SW is given as below. Using triangular method, compute the quantity of gas produced for first six years, if annual waste deposition is 1000 tons and 750 tons of RB and SB respectively. Gas production by RB is  $1\text{m}^3$  per kg; Gas production by SB is  $1.5\text{m}^3$  per kg; specific weight of methane =  $0.71\text{ kg/m}^3$ ; Specific weight of carbon-dioxide =  $1.97\text{ kg/m}^3$ . [8]

**OR**

Determine the amount of air required to completely oxidise one ton of solid waste having the chemical equation  $\text{C}_{68}\text{H}_{126}\text{O}_{80}\text{N}$ .

4. a) What is a landfill? Describe the criteria for land fill site selection. [8]

### Typical properties of residential MSW

Component of waste	Specific Weight (kg/m <sup>3</sup> )		Moisture Content (% by weight)		Energy content (kJ/kg)	
	Range	Typical	Range	Typical	Range	Typical
Food waste	130-480	290	50-80	70	3490-6980	46
Paper	40-130	90	4-10	6	11630-18610	167
Card board	40-80	50	4-8	5	13955-17445	162
Plastics	40-130	65	1-4	2	27910-37210	325
Textiles	40-100	65	6-15	10	15120-18610	174
Rubber	100-200	130	1-4	2	20930-27910	232
Leather	100-260	160	8-12	10	15120-19770	174
Yard waste	60-225	100	30-80	60	2325-18605	65
Wood	130-320	240	15-40	20	17445-19770	186
Glass	160-480	195	1-4	2	115-230	7
Tin cans	50-160	90	2-4	3	230-1160	7
Aluminum	65-240	160	2-4	2		-
Other metals	130-1150	320	2-4	3	230-1160	7
Dirt, ashes	320-1000	480	6-12	8	2325-11630	69

### Typical proximate analysis and energy data for materials found in residential MSW

Type of waste	Proximate analysis % by weight				No.
	Moisture	Volatile matter	Fixed carbon		
Food waste	70	21.4	3.6		
Paper	10.2	75.9	8.4		
Card board	5.2	77.5	12.3		
Plastics	0.2	95.8	2		
Textiles	10	66	17.5		
Rubber	1.2	83.9	4.9		
Leather	10	68.5	12.5		
Yard waste	60	30	9.5		
Wood	20	68.1	11.3		
Glass and mineral	2	-	-		
Metal, tin, cans	5	-	-		
Metal, ferrous	2	-	-		
Metal, non ferrous	2	-	-		

Typical data on the ultimate analysis of the combustible components in residential MSW						
Percentage by weight (dry basis)						
Material	Carbon	Hydrogen	Oxygen	Nitrogen	Sulphur	Ash
50	48	6.4	37.6	2.6	0.4	5
50	43.5	6	44	0.3	0.2	6
80	44	5.9	44.6	0.3	0.2	5
65	60	7.2	22.8	—	—	10
45	55	6.6	31.2	4.6	0.15	2.5
60	78	10	—	2	—	10
45	60	8	11.6	10	0.4	10
510	47.8	6	38	3.4	0.3	4.5
510	49.5	6	42.7	0.2	0.1	1.5
140	0.5	0.1	0.4	0.1	—	98.9
700	—	—	—	—	—	—
—	—	—	—	—	—	—
700	4.5	0.6	4.3	0.1	—	90.5
380	26.3	3	2	0.5	0.2	68

#### Residential, commercial and industrial solid wastes.

Non-combustible	Energy content (kJ/kg)		
	As collected	Dry	Dry ash-free
5	4180	13916	16700
5.4	15815	19734	18738
5	16380	17278	18240
2	32799	33471	37272
6.5	18515	20572	22857
9.9	25330	25637	28494
9	17445	18701	20892
0.5	6050	15126	15317
0.6	15445	19343	19499
96-99	195	200	140
94-99	700	742	737
96-99	—	—	—
94-99	—	—	—

- b) The authorities are planning to purchase a compaction truck for solid waste disposal for a mechanically loaded stationary container system. What is the size of compactor truck required if the container size is  $0.6\text{m}^3$ ? Following information are available: [8]

Container utilization factor = 0.7

Container unloading time = 0.05hr/container

Driving time between containers = 0.1hr/location

Average container number in each location = 12

One way haul distance = 29km

Compaction ratio = 2

Speed limit = 88km/hr

Time from garage to first container = 20 minutes

Time from last container to garage = 15 minutes

Trips per day to disposal site = 2

Working hours = 8 hr

Off-route factor = 0.15

At-site time = 0.1 hr

Haul time constants,  $a = 0.016 \text{ hr/trip}$ ;  $b = 0.011 \text{ hr/km}$

5. a) What is resource recovery? What are the various processing techniques used in resource recovery. [8]
- b) Describe organic waste recycling practices in Nepal. [8]
6. a) Discuss about the gas and leachate management in landfills. [10]
- b) The chemical formula of Lactate is  $\text{CH}_3\text{CHOHCOOH}$ . What is the approximate energy content of lactate? [6]
7. Write short notes on: [4×4]
- a) Haul container system
  - b) Landfill bottom liner configuration
  - c) Proximate analysis
  - d) Hazardous waste

\*\*\*

**Examination Control Division**  
**2068 Chaitra**

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Solid Waste Management (Elective I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
  - ✓ Attempt any **Five** questions.
  - ✓ The figures in the margin indicate **Full Marks**.
  - ✓ Assume suitable data if necessary.
  - ✓
1. a) How do you explain the importance of Integrated Solid Waste Management in present global condition of environmental degradation? [8]  
b) How do you estimate the solid waste quantity in your city? Explain any two methods. [8]
  2. a) Write down the procedure to calculate the heat value of chemical compounds in solid waste. [6]  
b) Calculate the size of the compaction truck required for mechanically loaded stationary container system if the container size is  $0.5\text{m}^3$ . The container utilization factor is 0.7, average number of the container in each location is 10, compaction ratio is 2, container unloading time is 0.05 hr/ container. The drive between the containers is 10 minutes/ location. The one way haul distance is 20 KM with speed limit of 88 KM/hr. The time required to travel from garage to first container location is 20 minutes and the time required to travel from disposal site to garage is 30 minutes. The truck has to make 2 visits to the disposal site per day with working of 8 hours. [10]
  3. a) State the waste collection services in practice. Recommend the suitable method for effective solid waste management. [6]  
b) Calculate the land area required for a city for landfilling with following data. [10]  
Average solid waste production rate = 0.2 Kg per capita/day  
Additional waste by industries/commercial area = 30% of domestic solid waste  
Density of solid waste after compaction =  $500\text{ kg/m}^3$   
Height of one lift = 4m  
No. of cells in a lift = 5  
Thickness of daily cover in cell = 15 cm  
Thickness of intermediate cover in each lift = 15 cm  
Total number of lifts = 6  
Projected population of city after 15 years of operation = 2,00,000  
No. of working days in a week = 5  
Assume necessary data if needed.
  4. a) Explain briefly about landfilling method suitable for your city. Mention your justification. [8]  
b) Illustrate briefly about the significance of promotion of composting method for effective management of solid waste in urban areas of Nepal. [8]
  5. a) State about the flow of materials in society with neat sketch. [8]  
b) How did the institutional solid waste management practice start in Nepal? What were major features of German projects in Kathmandu for solid waste management? [8]
  6. Write short notes on: (any four) [4×4]
    - a) Management of hazardous waste
    - b) Physical composition of municipal solid waste
    - c) Transfer station
    - d) Leachate treatment
    - e) Incineration of solid waste

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Solid Waste Management (Elective I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary table is attached herewith.
- ✓ Assume suitable data if necessary.

1. a) What is integrated solid waste management? Describe the various activities that are considered under ISWM. [10]
- b) The chemical formula of cellulose and methane are  $C_6H_{10}O_5$  and  $CH_4$  respectively. What would be the heat values of these compounds? [6]

2. Following is the theoretical landfill gas generation from readily biodegradable and slowly biodegradable fractions of the solid waste. Determine how much gas is produced each year for first six years if annual waste deposition is 650 tons and 450 tons of readily biodegradable and slowly biodegradable wastes respectively. Use triangular model. [16]

Gas production by readily biodegradable waste :  $1 \text{ m}^3/\text{kg}$   
Gas production by slowly biodegradable waste :  $1.5 \text{ m}^3/\text{kg}$

3. a) Elaborate various sources of solid waste in urban area. Discuss about hazardous wastes. [8]
- b) What is a transfer station? When is it required? Describe about various types of transfer stations. [8]
4. a) Determine the chemical equation of the solid waste with following composition. [12]

SN	Waste Type	Wet Weight kg (out of 100 kg)
1	Food waste	55
2	Paper	20
3	Yard waste	10
4	Glass	10
5	Textile	5

- b) What is a hammer mill? Describe the use of hammer mill in MRF? [4]
5. a) What is triangular model of landfill gas? Discuss the use of model in the case of readily biodegradable and biodegradable wastes. [8]
- b) Discuss various methods of aerobic composting of organic solid waste. [8]
6. Write short notes on any four of the following: [4×4]
- a) Sketch liner configurations used on the base of landfill sites
- b) Material recovery facility
- c) Role of grating in the furnace
- d) Time and motion survey in collection system
- e) Leachate management

\*\*\*

Typical Solid Waste Properties

Components	Density, kg/m <sup>3</sup>		Moisture, %		% by mass (dry basis)						Inert residue %	
	Range	Typical	Range	Typical	C	H	O	N	S	Ash	Range	Typical
Food wastes	120-480	290	50-80	70	48.0	6.4	37.6	2.6	0.40	5.0	2-8	5
Paper	30-130	85	4-10	6	43.5	6.0	44.0	0.3	0.20	6.0	4-8	6
Cardboard	30-80	50	4-8	5	44.0	5.9	44.6	0.3	0.20	5.0	3-6	5
Plastics	30-130	65	1-4	2	60.0	7.2	22.8	—	—	10.0	6-20	10
Textiles	30-100	65	6-15	10	55.0	6.6	31.2	4.6	0.15	2.5	2-4	2.5
Rubber	90-200	130	1-4	2	78.0	10.0	—	2.0	—	10.0	8-20	10
Leather	90-260	160	8-12	10	60.0	8.0	11.6	10.0	0.40	10.0	8-20	10
Garden trimmings	60-225	105	30-80	60	47.8	6.0	38.0	3.4	0.30	4.5	2-6	4.5
Wood	120-320	240	15-40	20	49.5	6.0	42.7	0.2	0.10	1.5	0.6-2	1.5
Glass	160-480	195	1-4	2	—	—	—	—	—	—	96-99	98
Tins/cans	45-160	90	2-4	3	—	—	—	—	—	—	96-99	98
Nonferrous metals	60-240	160	2-4	2	—	—	—	—	—	—	90-99	96
Ferrous metals	120-1200	320	2-6	3	—	—	—	—	—	—	94-99	98
Dirt, ashes, brickbats etc.	320-960	480	6-12	8	26.3	3.0	2.0	0.5	0.20	68.0	60-80	70

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Trail Suspension Bridge (Elective I) (CE725)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. (a) What are planning tools? Briefly, explain the planning process of trail bridges? (3+3)
- (b) How axis points of a bridge are fixed? What are the ways of measuring the distance between the axis points? (5+5)
2. (a) How cable geometry of a suspended bridge is controlled? Explain, with a neat diagram, the geometry of cable? (3+3)
- (b) In a suspension bridge, both the axis points are at 100 m level. The high flood level (HFL) mark has been found at 95.5 m. The distance between the axis points is 140 m. Determine the correct span of the bridge. Accordingly, draw the cable geometries of the bridge with preliminary calculations. (10)
3. (a) What are the types of foundations for LSTB and SSTB bridges? Describe them. (8)
- (b) Check the stability of anchorage foundation on soil using the following data. (8)

Number of main cables	nM	=	2Nos
Main cable tension	TMf	=	594.840kN
Cable inclination	$\beta_f$	=	23.123Deg
Sub-Soil at depth		=	3.200m
Friction angle of Sub- Soil	$\phi_1$	=	35.000deg
Unit weight of sub-Soil	$\gamma_1$	=	17.000kN/m <sup>3</sup>
Friction angle of backfilling soil	$\phi_2$	=	30.000deg
Unit Weight of backfilling soil	$\gamma_2$	=	15.000kN/m <sup>3</sup>
Ground bearing pressure	$\sigma_{perm}$	=	250.000kN/m <sup>2</sup>
<u>Minimum embedded depth</u>	T	=	2.000m
Back hight	H1		3.50m
Front hight	H2		3.00m
width	B		4.40m
length	L		6.50m
<u>Active pressure height</u>	Ha	=	2.00 m
Embedded depth	T	=	2.00 m
Unit weight of dry stone masonry	$\gamma_d$	=	17.00 kN/mm <sup>3</sup>
Unit weight of Cement masonry	$\gamma_m$	=	22.00 kN/mm <sup>3</sup>
Unit weight of Cement Concrete	$\gamma_c$	=	22.00 kN/mm <sup>3</sup>
4. (a) What are the forces to be considered to check the tower capacity in a suspension bridge design? How are these forces assessed in analysis of a tower? (4+4)
- (b) How do you determine geometry of windguy and wind ties for a suspended bridge? Explain it with neat sketch. (8)
5. (a) What are the construction approaches of a trail bridge? What are the critical stages of works to be monitored during the supervision of a community trail bridge construction? (4+4)
- (b) How sag setting works of suspended and suspension bridge is done at site? (8)

\*\*\*

Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject:** - Trial Suspension Bridge (EG735CE) (Elective I)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Show with sketches different types of trial bridges, existing in Nepal. What do you understand by SSTB standard trail bridge? How and when this SSTB standard trial bridge came in to practice in Nepal. [4+2+2]
- b) Write about the pre-stretching of wire ropes. What will happen, if the wire ropes used in the bridge are found not pre-stretched? Write about the sizes of cables, used in SSTB and LSTB bridges and their safety factors where do you use 13 mm cables? [2+2+2+2]
2. a) How do you classify soil and rock types to select the respective anchor blocks of such bridge? Give the sketches of all types of main anchor blocks of SSTB Suspended Bridge in accordance with soil and rock types. [5+5]
- b) Why do we need to carry out a triangulation in bridge survey? Give the sketches and describe the procedures for it. [6]
3. a) Derive the equation to find the relation between sag (b) and vertical distance from lowest point to saddles ( $f_H, f_L$ ): 
$$b = \frac{(\sqrt{f_H} + \sqrt{f_L})^2}{4}$$
 in an inclined suspended bridge, if the design span, level difference and the sag are known. Why do you limit the sag in a suspended bridge? [6+4]
- b) What do you understand by pretension in spanning cable in a Suspension Bridge and when it has to be considered in the design? What is the difference between full load calculations in SSTB Suspended and Suspension Bridge types? [2+2+2]
4. a) What do you understand by Drum Anchorage in a LSTB suspended bridge? Make their sketches. Write their differences for rock and soil types. [2+4+2]
- b) Check the safety of a Drum Anchorage block on rock (without anchor rods) against sliding and toppling, eccentricity and bearing capacity. [8]

Make calculation on following data:

(Assume data and figure if necessary)

Cable

Main Cable Tension,  $T_M = 1200$  kN

Handrail Cable Tension,  $T_H = 250$  kN

Cable inclination,  $\beta = 14$  deg

Rock parameter

Bearing capacity = 450 kN/m<sup>2</sup>

Angle of sliding friction = 35 deg

Foundation

Additional Load on foundation top,  $A = 100$  kN Arm from front of block,  $a = 6.0$  m

$B = 6.5$  m  $H1 = 2.6$  m

$L = 3.0$  m  $H2 = 1.2$  m

5. a) Calculate the length of a first suspender from the entrance (i.e near the tower) of a SSTB Suspension Bridge (span 111.0 m, Sag 9.0 m, Tower 11.05 m). Calculate quantities of standard and extra pieces. Calculate the total weight of that suspender. [4+2+2]
- b) Explain the process of hot dip galvanization. How do you check the quality of galvanization? [5+3]
6. a) Explain how wind load is calculated in tower of a suspension bridge. Describe which load combinations and wind loads on tower, cable and walkway are considered for calculating the loads acting on the Tower Foundation. [5+3]
- b) Describe the procedures how windguy arrangement is fitted in a suspended bridge. [8]

\*\*\*

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Suspension Bridge (Elective I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) What are the differences between Suspended and Suspension Bridges? Show with sketches when Suspension or Suspended bridges are preferred for particular topographic and hydrological condition of a site. [4+2+2]  
b) What do you understand by preliminary design of a trail bridge at site? Write down the procedures for a topographic survey of a LSTB trail bridge at site with sketches. [2+6]
2. a) Which wire ropes are used in trail bridges of Nepal? Write in detail about construction type and sizes of wire ropes used in LSTB and SSTB Trail Bridge of Nepal at present practice. [2+4]  
b) Why pre-stretching of wire rope is necessary in trail bridges? Describe the process of pre-stretching wire ropes and finding modulus of elasticity in detail. [3+7]
3. a) Calculate the hoisting sag of a suspended bridge from the following data. [8]  
Span of bridge = 160m      dead load sag = 8m  
diameter of cables = 36mm      Elevation difference between saddles = 0m  
Assume necessary data.  
b) How do you select drum anchorage in LSTB Bridge? What do you understand by minimum embedded depth required in LSTB foundation? Are SSTB drum anchorages similar to LSTB drum anchorages? Give sketches of these foundations. [2+2+4]
4. a) Define Hoisting Load Sag, Dead Load Sag and Full Load Sag. How they are calculated in LSTB and SSTB bridges? Is the process is same for D and N type bridges? [3+5+2]  
b) Give the sketch of wind-guy arrangement for a LSTB suspended bridge. How windguy cable size is designed? [2+4]
5. a) Draw a flow chart of Hot Dip Galvanizing process. How do you check quality of hot dip galvanization of bridge steel parts? [4+4]  
b) Describe how cables are hoisted in N-type trail bridges. How sag is set and what are the necessary equipments required at site for this work. [4+2+2]
6. a) Why maintenance is necessary in trail bridges? Explain different types of maintenance of trail bridges. [2+4]  
b) Check the safety of the windguy foundation on rock with the following data. [10]  
Cable tension,  $T = 175\text{kN}$   
Cable inclination,  $\beta = +2.5^\circ$   
Rock parameter: Bearing capacity =  $400\text{kN/mm}^2$   
Frictional Angles = 38 degree  
Foundation size (assume sketch of block):  
 $B = 4\text{-}5\text{m}$        $L = 3.2\text{m}$        $H1 = 2.2\text{m}$        $H2 = 1.6\text{m}$        $h_t = 0.8\text{m}$

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Trail Suspension Bridge (Elective I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) How do you determine High Flood Level (HFL) in trail bridge survey? What role does freeboard play in selecting bridge type and span? Describe in which condition suspended type bridge is favorable. [2+3+3]
- b) Write a note on types of cable used in Trail bridges of Nepal. Describe about pre-stretching procedural of cable. Make a sketch to show how thimble and bulldog grips are used in cable connection of Trail Bridge. [2+4+2]
2. a) How do you fix axis points and permanent pegs in trail bridge survey? Describe in detail, the methods to measure horizontal and vertical distance between axis points. [8]
- b) How soil/Rock is classified for selecting/designing SSTB D-type Bridge. Make sketches of all types of main foundation of SSTB D-type Bridge. [4+4]
3. a) Deduce the equation for calculating length of a cable hanged between saddles of an inclined D-type bridge, if the span (l), dead load sag (b) and level difference between saddles (h) are given. [8]
- b) What is the difference between cable geometries of SSTB and LSTB D-type bridges? Write down the sag/span ratios, fixed in both standards of suspended bridges. What are hoisting load sag and full load sag? How these sags are related to each other? [8]
4. a) How span and tower height of a LSTB suspension bridge is selected? How span, camber and tower height is related in LSTB and SSTB N-type bridges? Give sketches. [8]
- b) What are the major elements of a suspension bridge tower? How tower is erected at site? Give sketches of tower erection procedures. [8]
5. Calculate the surface area of middle and first suspenders of a 148.6m span suspension bridge in which dead load sag is 17.0m, tower height is 20.24m. Give sketches. Assume practicable lengths of: main cable clamp, turnbuckle, connecting hook to cross beam, extra length and standard length. [16]
6. What are the necessary safety factors to be checked for designing a safe main cable anchorage foundation of a suspension bridge? Design a main foundation for a N-type LSTB bridge for following data: [16]

Cable tension,  $T = 230\text{kN}$

Cable inclination,  $\beta = 25^\circ$

Rock parameter: Bearing capacity =  $5000\text{kN/mm}^2$

Frictional angles =  $38^\circ$

Foundation size (assume sketch of block):

$B = 5.5\text{m}$     $L = 6.5\text{m}$     $H1 = 4.0$     $H2 = 3.0$     $B = 0.5\text{m}$

\*\*\*

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Trial Suspension Bridge (Elective I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. (a) Briefly explain the standards and types of trail bridges? Which type of bridge is preferred? Why? (8)
- (b) How do you locate a trail bridge axis? (8)
2. Fix the dead load geometry of cables for an 80 m long trail suspended bridge based on the following data. Check the factor of safety in cable. Elevation difference between saddles = 2.0 m, Dead load of bridge per meter = 0.75 kN/m, Full load of bridge per meter = 4.75 kN/m (16)

Table 1: Cables Selection

Maximum Span for Walkway Width:		Cable Combinations				Weight of all Cables
70cm	106cm	Handrail Cables		Walkway Cables		8h
span [m]	span [m]	nos	Ømm	nos	Ømm	[kg/m]
50	40	2	26	2	26	10.04
90	60	2	26	2	32	12.62
100	75	2	26	4	26	15.06
120	105	2	26	4	32	20.22
---	120	2	32	4	32	22.80

Table 2: Cable properties

Table 2. Cable Properties								
Cable size, $\phi$ mm	Pre-stretched	Cable size used in	Number of wires	Metallic area	Unit mass	Min Breaking Load	Perm. Load	Remarks
				mm <sup>2</sup>	Kg/m	kN	kN	
13	Non	SSTB	7 x 7 (6 x 1)	73	0.64	103	34	Tensile strength of wire = 1.57 (kN/mm <sup>2</sup> )
26	Yes		7 x 19 (12 x 6 x 1)	292	2.51	386	129	
32				442	3.80	585	195	
36				560	4.81	740	247	
40		LSTB		691	5.94	914	305	Modulus Elasticity, E = 110 (kN/mm <sup>2</sup> )

3. (a) Check the safety of a windguy block on fractured rock based on the following data.  
Cable tension = 190 kN, Cable inclination = 3 deg., Bearing capacity = 800 kN/m<sup>2</sup>, angle of sliding friction,  $\phi_{sl} = 40$  deg.  $B = 3.0$  m,  $L = 1.5$  m,  $H_1 = 3$  m,  $H_2 = 1.5$  m,  $ht = 1.0$  m (8)
- (b) Briefly explain with sketches the types of anchorage blocks for different types and standards of trail bridges? (8)
4. (a) What are the critical stages of works to be monitored during the supervision of a trail bridge construction? Why? (8)
- (b) How sag setting works of suspended and suspension bridge is executed? Will dead load geometry of the bridges match the theoretical geometry after bridge erection? (6+2)
5. (a) Explain the cable-hoisting works for a suspended bridge? Why cable-hoisting sag is calculated in bridge site itself? (6+2)
- (b) How a wind bracing system is provided to resist wind loading in trail bridges? Explain with sketches. (8)
6. Write short notes on: (any two) (8+8)
- (a) Loadings in trail bridges
- (b) Walkway fitting works
- (c) Maintenance of trail bridges

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Trail Suspension Bridge (Elective II)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Explain the scope and importance of Trail Bridge in the context of Nepal. Sketch both types of trail bridge indicating major components. [4+4]  
b) How bridge is planned in different level and what are the socio-economical criteria for Trail Bridge. [4+4]
2. a) What are the loads to be considered in Trail Bridge design, explain in brief. Why live load on Trail Bridge vary? [3+2]  
b) Prepare a preliminary design for a suspended bridge of 172M span. Calculate hoisting sag also. [11]
3. a) Explain the topographic survey procedure used in Trail Bridge. [8]  
b) How you classify soil and rock for designing foundation in Trail Bridge. [8]
4. a) Check stability of foundation based on given data: [10]  
Types of foundation : wind guy block  
Cable tension : 114 KN  
Cable inclination : 4 degree  
Bearing capacity of rock : 550 KN/m<sup>2</sup>  
Angle of sliding friction : 45 degree  
Foundation dimension : B = 2.2M, H<sub>1</sub> = 2.1 M, H<sub>2</sub> = 1.7m, L = 2.4m, ht = 1.2m  
b) What are the different types of wind guy arrangement used in trail bridge. What are the differences between wind guy arrangement system used for D and N type Trail Bridge. [3+3]
5. a) Explain different types of Tower used in suspension bridge. What is the basic principle of modern tower design? [4+2]  
b) How tower height is calculated? Calculate the length of first suspender near the tower of suspension bridge having following data. [3+7]  
Span: 170.2M, Sag: 19.20m and tower height = 22.73m. Also calculate number of standard pieces and length of extra pieces.
6. a) What are the works included in major maintenance? Explain the different approaches being adopted in construction of Trail Bridge. [4+4]  
b) Explain the process of hot dip galvanization. How tower is erected in field? Explain with sketch. [4+4]

04L TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2066 Magh

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Trail Suspension Bridge (Elective II)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Explain in brief about historical development of trail bridge. Sketch both types of trail bridge indicating major components. [4+4]
- b) What are the technical and socio-economical feasibility criteria for long span trail bridge? Explain. [8]
2. a) How do you classify soil and rock in foundation design? How can you decide about the foundation type in a design? Explain. [5+3]
- b) Explain the survey procedure to be carried out for LSTB and SSTB trail bridge. [8]
3. a) Calculate factor of safety for a suspended bridge of 150m span with following data: dead load sag (bd) = 8.5m and number and diameter of cable = 4 \* 40mm, height difference = 5.0m,  $E = 110 \text{ KN/mm}^2$ . [10]
- b) What are the major loadings considered on trail bridge? Why the live load on trail bridge vary? [4+2]
4. a) Check stability of foundation based on following data: [12]
 

Anchorage type : Drum anchorage  
Foundation : On rock  
Inclined suspended : Left bank

Cable structures characteristics:

Number of main cable : 4 nos  
Main cable tension : 1320 KN  
Hand rail cable tension : 257 KN  
Cable inclination :  $10^\circ$

Rock parameters:

Friction angle :  $40^\circ$   
Unit weight of rock :  $19 \text{ KN/m}^3$   
Permissible ground bearing pressure :  $450 \text{ KN/m}^2$   
Minimum embedded depth : 1m

Foundation detail:

Front height ( $H_2$ ) : 2.1m  
Back height ( $H_1$ ) : 3.2m  
Width (B) : 5.5m  
Length (L) = 4.0m  
Additional load A = 200KN and a = 4.0m
- b) Sketch the windguy arrangement system with its salient features. [4]

5. a) Calculate length of third suspender from tower, if span = 131.8m, tower height (ht) = 17.74m and sag (bd) = 14m. Also calculate number of standard piece, length of extra piece, weight and surface area of suspender. [8]
- b) Describe the necessity of maintenance for trail bridges? Explain the works to be done on routine maintenance. [3+5]
6. Write short notes on: (any four) [4×4]
- a) Procedure for walkway fitting
  - b) Construction approaches for trail bridge
  - c) Hot dip galvanization
  - d) Bridge planning
  - e) Principle of tower design

\*\*\*

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

***Subject: - Trail Suspension Bridge (Elective I)***

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ **Necessary figures are attached herewith.**
- ✓ Assume suitable data if necessary.

1. (a) What are bridge planning tools? How these tools help in planning of trail bridges? (8)  
(b) How bridge sites are investigated to locate a bridge axis? How do you ensure high flood mark in the site? (6+2)
2. A 150 m long suspended bridge has to be designed to suit a site condition. Based on the following data, check the factor of safety of the cable.  
Dead load sag = 7.5 m, Diameter of cables = 2 nos. 36 mm, Elevation difference between saddles = 0 m  
Take  $E = 110 \text{ kN/mm}^2$ , Dead load of bridge per meter = 0.75 kN/m  
Full load of bridge per meter = 4.75 kN/m (16)
3. Check the stability of the foundation based on the data given in the drawing in page 2. (16)
4. (a) How suspender lengths are calculated? What are differences in suspenders of LSTB and SSTB N type suspension bridges? (4+2)  
(b) Explain with sketches, how a wind bracing system is designed to resist wind loading. (10)
5. (a) What are the critical stages of works to be monitored during the supervision of a trail bridge construction? Why? (6+2)  
(b) Explain cable-hoisting works for a suspended bridge? Why cable-hoisting sag is calculated in bridge site itself? (2+6)
6. Write short notes on: (any two) (8+8)
  - (a) Loadings in trail bridges
  - (b) Maintenance of trail bridges
  - (c) Final Checking of bridges



Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject:** - Transportation Planning and Engineering (Elective I) (CE725)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

- Describe the basic steps in transportation planning and explain why the transportation planning process is not intended to furnish a decision. [4+4]
- Explain the different factors that affect non-motorized travel demand. What are the advantages and disadvantages of road side interview survey? [4+4]
- Classify trips. What are the different factors that affect trip production and attraction? [4+4]
- A small study area represented by six traffic zones has the following characteristics. [8]

Zone	1	2	3	4	5	6
Trip Production	600	450	900	850	750	290
Car ownership	250	200	710	615	280	130

Derive a trip generation equation and calculate  $R^2$  value.

- Explain the issues that should be considered in making evaluation of alternatives. [8]
- What are the aircraft characteristics? Explain how they influence in airport site selection. [8]
- The length of runway under standard conditions is 1500 m. The airport is to be provided at an elevation of 110 m above mean sea level. The mean of maximum and the mean of average daily temperatures of the hottest month are 32.8°C and 16.5°C respectively. The construction plan includes the following data: [8]

End to end of runway (m)	0-300	300-900	900-1500	1500-1800	1800-2100
Grade (%)	+1	-0.20	+0.50	+1.00	-0.30

Determine the actual length of runway to be provided. Apply corrections for elevation and temperature as per ICAO and for gradient as per FAA specifications.

- What are the different types of railway stations and yards? Briefly explain with their functions. [4+4]
- A 600 m radius curve is introduced between two tangent portions of a BG line intersecting to form a deviation angle of 70°. The booked speed for goods train in the section is 50 kmph and the maximum sanctioned speed is 110 kmph. Calculate the cant to be provided, maximum permissible speed, length of transition curve and cant gradient. Limits for maximum cant and cant deficiency are 165 mm and 100 mm respectively. [8]
- Is gravity goods ropeway a viable alternate mode of transport in Nepal? Explain its limitations. [8]

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject:** - Transportation Planning and Engineering (EG785CE) (Elective II)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Write down the steps of implementation of road transportation projects in Nepal. Describe the role of Department of Roads. [6+2]
- b) 'Transportation Planning is continuous process' elaborate the statement. Write down the differences between short term and strategic planning. [4+4]
2. a) Differentiate urban and regional planning. Write down the difficulties in the 'freight demand estimation. [2+6]
- b) Define the elasticity based model. Explain the Origin -Destination Survey. [2+6]
3. a) What is trip generation? Total trips produced in and attracted to the three zones A, B, C of a survey area in the design year tabulated as:

Zones	Trips produced	Trips attracted
A	1500	1200
B	1200	2000
C	2000	1500

- It is found that trips between two zones are inversely proportion to the second power of the travel time between zones, which is uniformly 25 minutes. If the trip interchange between zones B and C is known to be 600, calculate the trip interchange between zones A and B, A and C, B and A and C and B. [2+6]
- b) Describe the initiations for the development of railways and water transport in Nepal. Write down the application of 'Logit model' in urban transport modeling system. [4+4]
  4. a) Describe the effect of 'head wind' and 'tail wind' during the landing and take-off. Make a neat sketch of an aircraft showing its component. [4+4]
  - b) Make a typical layout plan of an airport. Calculate the corrected length of runway for the given condition:
    - Reference temperature for the airport site is 18°Celcius
    - Basic length of runway is 980 m
    - Altitude above mean sea level is 600m
    - Runway Gradient is 0.20%
 [2+6]
  5. a) Make a typical cross of single line BG railway track. Make a sketch of left hand turn-out of railway track. [4+4]
  - b) Calculate the superelevation and maximum permissible speed for a 2° curve on a high speed BG track with the following data: [8]
    - Maximum sanctioned speed = 140 kmph
    - Equilibrium speed = 75 kmph
    - Booked speed for goods train = 45 kmph
  6. Write short notes on: (any four) [4×4]
    - a) Factors affecting mode choice
    - b) Generation of alternatives
    - c) Wind rose, cross-wind component, wind-coverage
    - d) Types of gradients in railways
    - e) Classification of rural transport network in Nepal

02H TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2068 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject:** - Transportation Planning and Engineering (*Elective II*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

- 1 a. Elaborate the statement 'Transport planning is the continuous process'. Describe transportation network and their characteristics. [8]  
b. Explain that 'the travel demand is dependable to the population growth & its economic activities'. Make a sketch of Land-use and transport cycle [8]
- 2 a. Describe the 'economic location theory'. Mention the factors affecting the relative desirability of a location of an economic activity. [8]  
b. What are the major transportation problems in urban areas? How they can be solved by conventional approach? [8]
- 3 a. On a BG route involving high speed, a 100 m transition curve has been provided and a superelevation of 70 mm has been managed. The degree of curve is 1.5 and the maximum sanctioned speed for the curved section is 160 kmph. Determine maximum permissible speed on the curve. [8]  
b. Calculate the superelevation for 1.5° curve on a high speed BG track with the maximum sanctioned speed of 120 kmph, equilibrium speed is 75 kmph and speed for goods train is 50kmph. [8]
- 4 a. Write down the factors affecting the airport site selection. Describe the use of Wind-Rose diagram in runway orientation. [8]  
b. Basic length of runway is 1200 m. The airport site has an elevation of 600 m. Its reference temperature is 20.0° C. If the runway is to be constructed with an effective gradient of 0.25%, determine the corrected length of Runway. [8]
- 5 a. What are the major types of transportation survey? What are the types of information to be collected during road-side interview method? [8]  
b. What are components of an aircraft? Describe them with neat sketch. [8]
- 6 **Write short note on: (any Four)** [4X4]
  - a. Gravity model
  - b. Cross wind component and Wind coverage
  - c. Left hand railway Turn-out
  - d. Rolling stock of railway
  - e. Momentum and Pusher gradient

\*\*\*

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject:** - Transportation Planning and Management (Elective I)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

- 1 a. What is the scope of transportation planning? Define accessibility and mobility. [8]
- b. Basic length of runway is 1200 m. The airport site has an elevation of 700 m. Its reference temperature is  $18^{\circ}\text{C}$ . If the runway is to be constructed with an effective gradient of 0.15%, determine the corrected length of Runway. [8]
- 2 a. What is the 'travel demand'? Describe the steps of travel demand forecasting model for Urban transportation planning? [8]
- b. What is the importance of O-D study? Describe the use of O-D data in the transportation planning? Describe the data to be collected by home interview method. [8]
- 3 a. What is evaluation of alternatives? Mention the principles for generating alternatives during transportation planning? [8]
- b. What are the organizations involved in planning in Nepal? Describe the role Department of Roads as an implementing agency. [8]
- 4 a. What are factors to be considered during site selection of an airport? [8]
- b. Total trips produced in and attracted to the 3 zones A, B, C of a survey area in the design year is tabulated as: [8]

zones	Trips produced	Trips attracted
A	1200	1400
B	1500	1200
C	1400	1500

It is known that the trips between two zones are inversely proportion to the second power of the travel time between zones, which is uniformly 15 minutes. If the trip interchange between zones B and C is known to be 500, calculate the interchange between zones A and B, A and C, B and A and C and B

- 5 a. Calculate the superelevation and maximum permissible speed for 3 degree curve on a high speed BG track. [8]
  - a. Maximum sanction speed = 130 kmph
  - b. Equilibrium speed = 85 kmph
  - c. Speeds for goods train = 50 kmph
- b. What are the component parts of rolling stock of railway? Calculate the material requirements for one Km of BG railway track. [8]
- 6 Write short note on: (any Four) [4X4]
  - a. Right hand turn-out
  - b. Railway stations: functions and types
  - c. Advantages of air transportation
  - d. Jet engine
  - e. Gravity model

06R TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2068 Chaitra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject:** - Transportation Planning and Engineering (Elective I)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five**.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1.
  - a. List out the responsible agencies for planning in Nepal and mention their roles for planning. [2+6]
  - b. Describe the scope of transportation planning in brief. [2+6]
2.
  - a. What is difference between urban and regional Planning? Describe the 'economic location theory' and factors affecting the relative desirability of a location. [2+6]
  - b. List out the methods of transport survey. Explain the home interview method. [2+6]
3.
  - a. Total trips produced in and attracted to the three zones A, B, C of a survey area in the design year tabulated as:

Zones	Trips produced	Trips attracted
A	4000	2000
B	3000	4000
C	2000	3000

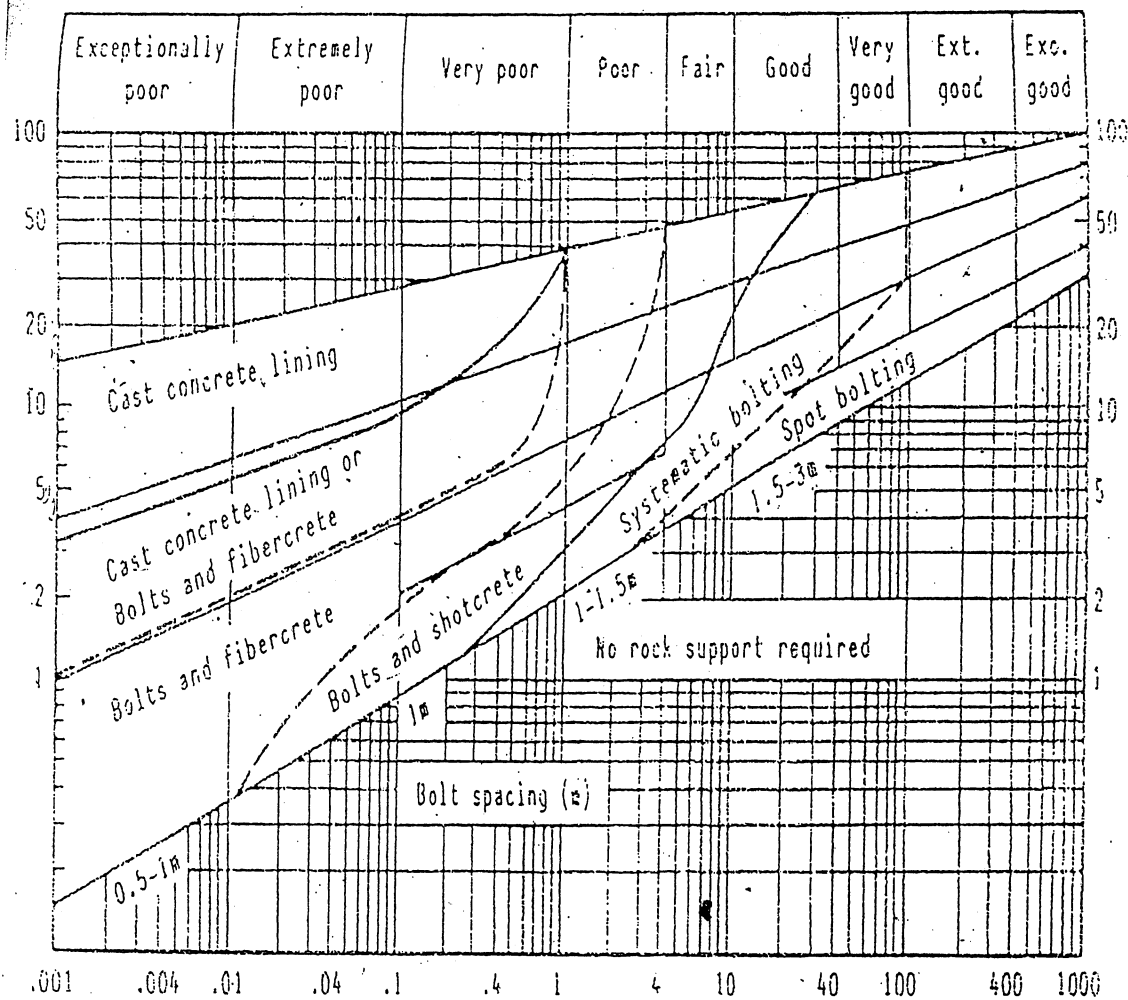
It is known that the trips between two zones are inversely proportion to the second power of the travel time between zones, which is uniformly 20 minutes. If the trip interchange between zones B and C is known to be 900, calculate the trip interchange between zones A and B, A and C, B and A and C and B.

- b. Make a flow chart of 'Urban Transport Planning Process'. Describe the application of logit model in urban transport modeling system. [4+4]
4.
  - a. What are the components of an aircraft? Make a neat sketch of an aircraft. [8]
  - b. Make a layout plan of an airport. Calculate the corrected length of runway for the given conditions:
    - Reference temperature for the airport site is 20° Celcius
    - Basic length of runway is 1280 m
    - Altitude above mean sea level is 900 m
    - Runway Gradient is 0.25%
 [8]
5.
  - a. What are the components of rolling stock of railway? Make a sketch of right hand turn-out of railway track. [4+4]
  - b. Calculate the superelevation and maximum permissible speed for a 2° curve on a high speed BG track with the following data:
 

— maximum sanctioned speed =	150 kmph
— equilibrium speed =	80 kmph
— booked speed for goods train =	55 kmph

 [8]
6. Write short note on: (any Four) [4X4]
  - a. Factors affecting trip generation
  - b. Cross wind component, wind coverage & wind rose
  - c. Evaluation criteria of transportation projects
  - d. Types of railway stations
  - e. Transportation systems in Nepal

Equivalent dimension =  $\frac{\text{span, diameter or height}}{\text{ESR}}$



$$\text{ROCK MASS QUALITY } Q = \left( \frac{RQD}{J_n} \right) \left( \frac{J_r}{J_a} \right) \left( \frac{J_w}{SRF} \right)$$

04H TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2067 Mangsir

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject:** - Transportation Planning and Engineering (*Elective II*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

- 1 a. What are main organizations involved in planning in Nepal? Describe the role of executing agency (line Ministry)  
b. What is Transport Planning? Describe the scope of Transport Planning.
- 2 a. Describe the model connecting vehicles, infrastructure and passengers for the planning of passenger movement.  
b. What are the major transportation problems in urban areas? How they can be solved by conventional approach?
- 3 a. What are the major types of transportation survey? Describe the Road Side Interview Survey.  
b. Consider a zone with 300 households with a motorcycle and 200 households without motorcycle. Assuming we know the average trip generation rate of each group:
  - Motorcycle owning household produce: 6 trips /day
  - Household without motorcycle produce: 3 trips /dayCalculate the total trips after 15 years when all houses will have a motorcycle. Assume income and population remain constant.
- 4 a. What are the component parts of an aircraft? Describe them with neat sketches.  
b. Basic length of runway is 1520 m. The airport site has an elevation of 750m. Its reference temperature is 22.5° C. If the runway is to be constructed with an effective gradient of 0.20%, determine the corrected length of Runway.
- 5 a. On a BG route involving high speed, a 100 m transition curve has been provided and a superelevation of 70 mm has been managed. The degree of curve is 1.5° and the maximum sanctioned speed for the curved section is 160 kmph. Determine maximum permissible speed on the curve.  
b. What are the component parts of railway track? Describe their functions. Make a sketch of a single line railway track cross-section.
- 6 Write short note on: (any Four)
  - a. Facilities for 'Airport Terminal Building'
  - b. Left hand railway Turn-out
  - c. Minimum turning radius of aircraft
  - d. Railway stations
  - e. Cross wind component and Wind coverage

\*\*\*

05G TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2067 Ashadh

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject:** - Transportation Planning and Engineering (*Elective I*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
  - ✓ Attempt any **Five** questions.
  - ✓ The figures in the margin indicate **Full Marks**.
  - ✓ Assume suitable data if necessary.
- 
- 1
    - a. Define transportation planning. Describe transportation network and their characteristics .
    - b. How land-use affects on the travel demand? Describe Land-use and transport cycle
  - 2
    - a. Importance of 'Center place studies and geography of concentration'?
    - b. What are the major transportation problems in urban areas? How they can be solved by conventional approach?
  - 3
    - a. What are the major types of transportation survey? What are the types of information to be collected during home interview method?
    - b. Calculate the superelevation for 2<sup>o</sup> curve on a high speed BG track with the maximum sanctioned speed of 140 kmph, equilibrium is 85 kmph and speed for goods train is 50kmph.
  - 4
    - a. What are the advantages of air transport? Describe the use of Wind-Rose diagram in runway orientation.
    - b. Basic length of runway is 1280 m. The airport site has an elevation of 750m. Its reference temperature is 20.0° C. If the runway is to be constructed with an effective gradient of 0.20%, determine the corrected length of Runway.
  - 5
    - a. On a BG route involving high speed, a 120 m transition curve has been provided and a superelevation of 80 mm has been managed. The degree of curve is 1.5 and the maximum sanctioned speed for the curved section is 170 kmph. Determine maximum permissible speed on the curve.
    - b. What are the different types of stations used in railway? Make a sketch of a single line railway track cross-section.
  - 6 Write short note on: (any Four)
    - a. Cross wind component and Wind coverage
    - b. Three controls: Aileron, Elevator & Rudder
    - c. Left hand railway Turn-out
    - d. Rolling stock of railway
    - e. Airport site selection

\*\*\*

04C TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2066 Magh

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject:** - Transportation Planning and Engineering (*Elective II*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

- 1 a. Define Transportation Planning. Describe 'Land-use Transportation Cycle'. [8]  
b. Find out the length of transition curve for a four degree BG circular curved track having a cant of 15 cm. the maximum permissible speed on the curve is 90 kmph. Find out the shift and offset at every 15 m interval of the curve. [8]
- 2 a. Write down the importance of central place studies and geography of concentration. [8]  
b. What are major types of 'Transportation Survey'? Describe the data to be collected by home interview method. [8]
- 3 a. Make a schematic diagram of Urban Transportation Planning Process. [8]  
b. Describe the transportation systems in Nepal. What are the constraints to the development of each modes of transportation? [8]
- 4 a. What are factors to be considered during site selection of an airport? [8]  
b. Basic length of runway is 1280 m. The airport site has an elevation of 750m. Its reference temperature is 20° C. If the runway is to be constructed with an effective gradient of 0.25%, determine the corrected length of Runway. [8]
- 5 a. On a BG route involving high speed, a 120 m transition curve has been provided and a superelevation of 80 mm has been managed. The degree of curve is 1° and the maximum sanctioned speed for the curved section is 170 kmph. Determine maximum permissible speed on the curve. [8]  
b. What are the component parts of rolling stock of railway? Calculate the material requirements for one Km of BG railway track. [8]
- 6 Write short note on: (any Four) [4X4]
  - a. Advantages of air transportation
  - b. Jet engine
  - c. Railway stations: functions and types
  - d. Right hand turn-out
  - e. Gravity model

\*\*\*

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject:** - Transportation Planning and Engineering (*Elective I*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) What is transportation planning? Explain Land-use Transport cycle. [8]
- b) Total trips produced in and attracted to the three zones A, B, C of a survey area in the design year tabulated as:

Zones	Trips produced	Trips attracted
A	3000	2000
B	2000	1000
C	1000	3000

It is known that the trips between two zones are inversely proportion to the second power of the travel time between zones, which is uniformly 20 minutes. If the trip interchange between zones B and C is known to be 700, calculate the trip interchange between zones A and B, A and C, B and A and C and B. [8]

2. a) What are Component parts of rolling stock of railway? Describe them in short. [8]
- b) Make a flow diagram of four step urban transportation modeling system. [8]
3. a) Basic length of runway is 1280 m. The airport site has an elevation of 1000 m. Its reference temperature is 20 degree Celsius. If the runway is to be constructed with an effective gradient of 0.3%, determine the corrected runway length. [10]
- b) What are the component parts of an aircraft? Make a sketch showing minimum turning radius of an aircraft. [6]
4. a) On a B.G route involving high speed, a 110 m transition curve has been provided and a superlevation of 80 mm has been managed. The degree of curve is  $1.5^\circ$  and the maximum sanctioned speed for the section is 160 kmph. Determine maximum permissible speed. [10]
- b) Make a sketch of a cross section of runway showing its typical dimensions. Make a general layout of airport showing its parts. [6]
5. a) Write down the six principles of development of a set of alternatives. [8]
- b) What are the types and methods of transportation survey? Describe home interview survey in detail. [8]
6. Write short notes on (any four)
  - a. Left hand Railway turn-out
  - b. Characteristics of transportation network
  - c. Airport terminal facilities
  - d. Railway stations
  - e. Transportation systems in Nepal

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Urban and Regional Planning (Elective I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What do you understand by Human settlements? What are the factors responsible for human settlement? (6+10)
2. What do you understand by urbanization? Discuss the urbanization trend in Nepal? (6+10)
3. What are the regional planning theories? Explain the central place theory? (6+10)
4. As an urban planner, how do you see the urban issues and problems? What shall be your efforts in solving these issues? (6+10)
5. In the context of Nepal, how do you understand by land readjustment as an urban planning tool? Describe advantages and disadvantages of this planning tool? (6+10)
6. Project population for each development region for 2005, 2010, 2015 from the following information by using arithmetic, geometric and exponential function : (16)

Development region	Population 1991	Population 2001	Growth rate
Eastern	4446749	5344476	2.02
Central	6183955	8031629	2.99
Western	3770678	4571013	2.12
Mid western	2410414	3012975	2.5
Far Western	1679301	2191330	3.05

\*\*\*

06J

TRIBHUVAN UNIVERSITY

INSTITUTE OF ENGINEERING

**Examination Control Division****2068 Chaitra**

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 Hrs.

**Subject: - Urban and Regional Planning (Elective I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. As an urban planner, how do you see the urban development opportunities and problems in Nepal? What shall be your strategy in solving such problems? (10+6)
2. What do you understand by housing? Explain the concept 'Janata Aawash Program' of Nepal. Discuss the merits and demerits of informal housing in Nepal. (4+6+6)
3. What is Human settlement? Discuss the physical components of human settlement. Describe the different types of human settlements. (2+8+6)
4. What is transportation system in the context of regional development? Explain the different modes of transportation system for sustainable development of regions of Nepal. (6+10)
5. As an urban planner, what do you understand by urban land use? Describe various factors that determine land use. (6+10)
6. Project population for three development regions for 2015, 2020, from the following information by using arithmetic, geometric and exponential function : (16)

Development region	Population 2001	Population 2011	Growth rate
Eastern	4446749	5344476	2.02
Western	3770678	4571013	2.12
Far Western	1679301	2191330	3.05

\*\*\*

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

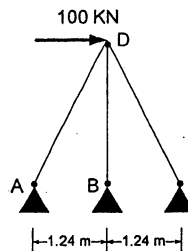
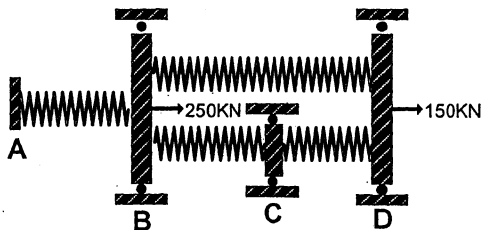
**Subject:** - Computational Structural Mechanics (*Elective I*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Four** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. A. What do you mean by tensor? Evaluate  $\delta_{ij}b_j$  and  $\delta_{ij}F_{ik}$  [10]
- B. Evaluate the Invariants  $I_1$ ,  $I_2$  and  $I_3$  for the stress tensor  $\sigma_{ij}$  given below. Find principal stress tensor. Also show that the invariants of given tensor and principal tensor is same. [10]

$$\sigma_{ij} = \begin{pmatrix} 6 & -3 & 0 \\ -3 & 6 & 0 \\ 0 & 0 & 8 \end{pmatrix}$$

2. A. A three span beam ABCD is made of mild steel with initial modulus 200 GPa. Node A is fixed and node B, C and D have vertical roller as boundaries. The span AB, BC and CD are 5 m, 4 m and 3 m respectively. There is uniformly distributed load of 40 kN/m over the span CD and point load of 100 kN at the mid span of BC. The whole span is made up of ISMB 250 with following properties. Analyze the beam using direct stiffness method and draw free body diagram and bending moment diagram. [10]
- B. Analyze the unidirectional collinear spring system shown below. All the springs have stiffness 200 kN/mm. [10]



3. Determine the support reaction and member end forces of the truss system shown above. Assume supports A and C settle down by 5 mm each. [20]

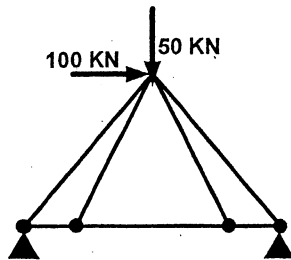
Member	Length (m)	Area (mm <sup>2</sup> )	E (kN/mm <sup>2</sup> )
AD	1.80	1200	200
BC	1.30	1000	200
CD	1.80	1200	200

4. A. List out the different methods to consider skew boundary conditions. Describe one of them with suitable numerical example and sketches of any truss structure. [10]

B. A simply supported beam AB 6 m long has elastic rotational spring with stiffness  $0.15 EI$ /radian clockwise at the centre of span C. In span BC there is uniform load intensity of  $60 \text{ KN/m}$  and in span AC there is concentrated load of intensity  $240 \text{ KN}$  at the center of span. The material is mild steel and section is ISMB 250 with following properties for both spans. [10]

Section	Unit weight(KN/m)	Area ( $\text{mm}^2$ )	E ( $\text{KN/mm}^2$ )	Moment of Inertia ( $\text{cm}^4$ )
ISMB250	0.373	4755	200	5131.6

5. A. The structure shown below is symmetric. Decompose the load into symmetric and anti-symmetric components and sketch the sub structures for symmetric and anti-symmetric response. All elements have equal EA. [10]



- B. A two span continuous beam has three degrees of freedom as  $U_1$ ,  $U_2$  and  $U_3$  and the two spans have total potential energy expressed as:

$$\pi_1 = 12U_1^2 + 18U_1U_2 + 20U_2^2 - 2U_1 - 3U_2$$

$$\pi_2 = 6U_2^2 + 8U_1U_2 + 10U_3^2 - 5U_2 - 7U_3$$

Determine the stiffness equation and also the values of  $U_1$ ,  $U_2$  and  $U_3$ .

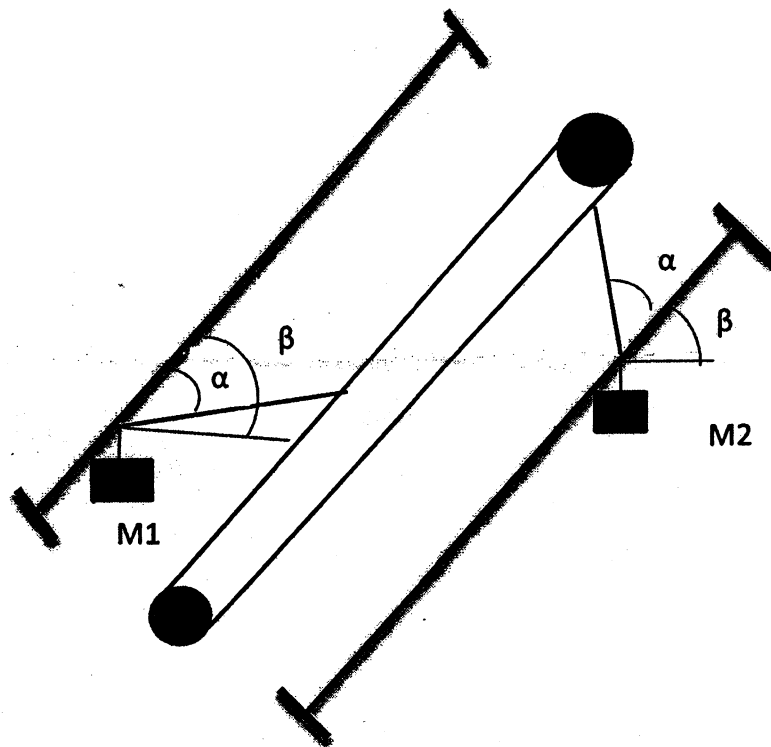
[10]

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Ropeway Engineering (Elective I) (CE725)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What are the advantages of Ropeway transportation in comparison to other modes of transportation. [6]
2. Social and economic feasibility should precede the technical feasibility in Gravity Goods Ropeway. Elaborate the statement. Discuss the major social and economic factors that need to be considered during the feasibility study of the Gravity Goods Ropeway. [8]
3. a) Draw a neat sketch of a wire rope and label its components. Explain the function of core in wire rope and differentiate between various types of cores. [5]
  - b) What does lay refer in the wire ropes? Distinguish between the Lang lay and ordinary lay wire rope with neat sketch. [5]
4. The following is the schematic diagram of a Gravity Goods Ropeway. Derive equations to obtain the acceleration of the moving trolleys where  $M_1$  and  $M_2$  are the mass of the downward and upward moving trolley respectively. [6]



5. Derive an equation for obtaining rope Geometry in Ropeways. Write down the relationship between the rope length and the maximum rope sag. [8]
6. Determine the maximum weight the ropeway with the following features can safely carry in all the loading conditions [10]
 

Saddle to Saddle vertical distance	:	449 m
Saddle to saddle horizontal distance	:	1010m
Diameter of the track rope	:	12mm
Diameter of the haulage rope	:	9 mm

Angle made by the track rope at the upper saddle at the dead load condition ( $\beta$ )  
: 32 degree

The unit weight of track rope and haulage rope are 0.59kg/m and 0.301kg/m respectively. Consider the wind load corresponding to 160km/hr
7. In the above GGR, calculate minimum height of anchorage block necessary at bottom station if the length and breadth of the block is limited to 3.2m and 2.2m respectively. Consider that the track rope is directly anchored to the block. Assume all the necessary data. [7]
8. List major items you need to consider in the estimation and costing of Gravity Goods Ropeway [5]
9. What are the general safety precautions to be observed in the Gravity Goods Ropeways? [4]
10. Explain the wire rope erection procedures briefly [5]
11. What are the major defects in wire ropes? How are the following tests conducted? What are their importance? [5]
  - a) Reverse bend test b) Torsion test
12. What is pre stretching? How is it carried out? Why is pre stretched rope preferred in the Ropeways? [6]

\*\*\*

06F TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2072 Ashwin

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject:** - Disaster Risk Management (*Elective III*) (CE78506)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. What are the key factors to be considered while planning the rehabilitation and reconstruction works after a major disaster, refer EQ 2015 of Nepal. Mention the different phases of disaster management.
2. Explain how search and rescue operation have to be carried out in the case of collapse of buildings due to earthquake and landslide. What precautionary measures have to be taken in the search and rescue schemes in case of structural damages and mass movements?
3. What kinds of natural disasters are common to Nepal which poses the greatest threat to life and property?
4. Explain cluster approach for disaster risk management. List out the assessment types and techniques to mitigate the disasters.
5. How do you protect human rights in disaster situation? How do you protect the rights of vulnerable groups and the children? Explain the managerial aspect of land and property in disaster situation. Also explain the possible risk to corruptions in the disaster risk reduction activities.
6. What is disaster risk management? Differentiate DRR and DRM.
7. Define hazard risk vulnerabilities and mitigation.
8. Distinguish disaster with emergencies. Explain the role of social economic dimension in vulnerability.
9. List the disaster management circle. Describe the pre disaster activities.
10. What is Risk assessment and risk analysis? Describe the different types of risk analysis method.

\*\*\*

Exam.	Regimen		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Time Series Analysis (Elective III) (CE78505)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain the following terms: deterministic process, white noise, marginal distribution, parsimony of parameters [4x2]

2. Define the univariate and multivariate time series and stationary and non-stationary time series data. [2+2]

3. The duration of a monsoon storm X is a random variable whose probability density function is given by [2+2+2]

$$f(x) = kx^2 \text{ for } 0 \leq x \leq 6h$$

$$= k(12-x)^2 \text{ for } 6h \leq x \leq 12h$$

$$= 0 \text{ elsewhere}$$

Find the value of k. What is the probability that the duration of the storm is between 6h to 9h.

\* What is the probability that the duration of the storm is between 6h to 9h, given that the storm has lasted from 6h?

4. Define central limit theorem. How is this concept useful for the analysis of hydrological time series data? [2+2]

5. The annual runoff of a stream is modeled by a normal distribution, with mean = 4100 m<sup>3</sup>/s and standard deviation = 750 m<sup>3</sup>/s. Find the ranges which is symmetrical about mean within which the runoff will lie with a probability of 0.5. Also, compare the range using Chebyshev's inequality concept and comment on the result.

For normal distribution, take Z = 0.675 for F(Z) = 0.75 and Z = -0.675 for F(Z) = 0.25. [4+4]

5. (a) What is autocorrelation analysis? How is it useful for the investigation of the time series data? [2+6]

(b) Obtain the parameters of AR(2) model from Yule-Walker equation. Also, discuss the condition of stationarity and the nature of autocorrelation function of AR(2) model with sketches. [2+2+4]

6. (a) Show that the autocorrelation function for MA(m) model is

$$\rho_k = \frac{(-\beta_k + \beta_1\beta_{k+1} + \beta_2\beta_{k+2} + \dots + \beta_{m-k}\beta_m)}{(1 + \beta_1^2 + \beta_2^2 + \dots + \beta_m^2)}$$

Where  $\rho_k$  = autocorrelation coefficient for lag k, m = order of model and  $\beta$  = parameter of model. [8]

7. Explain the Thomas-Fiering model for generating seasonal flows [8]

(b) Assuming an ARMA(1,1) model is a good fit to describe the normally distributed annual flows of a stream whose mean, standard deviation, first and second serial correlation coefficients of observed annual flows of a stream are estimated to be 1210 Mm<sup>3</sup>, 570Mm<sup>3</sup>, 0.535 and 0.463 respectively. Generate a sequence of 3 annual flows using the following independent standard normal random numbers 1.123, -0.821 and -0.342. [10]

8. Generate a chain of 6 uniformly distributed random numbers in the range 0 to 0.999 using the mixed congruential generator. Take multiplier = 361, increment = 56377, modulus = 10<sup>5</sup> and seed = 42765. [8]

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject:** - Time Series Analysis (Elective III) (CE 78505)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Differentiate between deterministic and random process. [3]
2. What is trend in time series? Discuss two methods for the detection of trend. [1+4]
3. (a) Discuss the methods for the selection of proper probability distribution. [6]  
(b) The probability density function of a random variable is given by [6]  

$$f(x) = 5x(1-x) \text{ for } 0 < x < 1$$

$$= 0 \text{ elsewhere}$$

Find the probability that  $x$  will take on a value within 2 times standard deviations of the mean and compare it with the lower bound provided by Chebyshev's inequality.
4. (a) Define autocorrelation with relevant equations? How is it useful for the investigation of independent process? [3+5]  
(b) The first serial correlation coefficient of MA(1) process is 0.27. Compute the parameter and variance of the process. Take the variance of random variable = 1.5. [2+2]
5. (a) Starting from Yule-Walker equation for AR(m) model, obtain the parameters of AR(1) and AR(2) model. Also explain the nature of autocorrelation function of AR(1) model with sketches. [2+2+3]  
(b) Classify the following process as AR, MA or ARMA and compute first four serial correlation coefficients. [1+8]  

$$(X_t - \mu) = 0.7(X_{t-1} - \mu) + e_t - 0.5e_{t-1}$$
6. (a) Explain the Thomas-Fiering model for generating seasonal flows. [8]  
(b) The mean, standard deviation, first and second serial correlation coefficients of observed annual flows of a stream are estimated as 450 Mm<sup>3</sup>, 130 Mm<sup>3</sup>, 0.7 and 0.45 respectively. Generate a sequence of 5 annual flows assuming that the flows are normally distributed and taking the chain of 5 standard normal random numbers as 1.235, 0.596, -0.813, 0.819, -0.056. Use AR(2) model. [10]
7. (a) Explain the central limit theorem method for the generation of normally distributed random numbers. [6]  
(b) Using the sequence of uniform random numbers in pairs given below, obtain the sequence of normal random numbers using Box-Muller method. [8]

$u_1$	$u_2$
0.576	0.249
0.588	0.322
0.470	0.670
0.157	0.350

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Time Series Analysis (Elective III) (CE78505)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. List the applications of time series modelling in water resources engineering. [3]
2. What is stationarity? Discuss the approach for testing stationarity of time series. [1+4]
3. a) Explain the methods for the determination of parameters of probability distributions. [5]  
b) The annual rainfall at a place is found to have a mean 740 mm and standard deviation 400 mm. Find the ranges within which the rainfall will lie with a probability of at least 0.5. Use Chebyshev's inequality. [7]
4. a) What are different types of periodic series? Describe each of them in brief. [4]  
b) For MA (2) process, following data are given:  $r_1 = 0.36$ ,  $r_2 = -0.2$ . Compute parameters  $\beta_1$  and  $\beta_2$ . [6]
5. a) Discuss the nature of autocorrelation function of AR(1) and AR(2) model with sketches. [3+4]  
b) Classify the following process as AR, MA or ARMA and compute first four serial correlation coefficients. [1+8]  
$$(X_t - \mu) = 1.3(X_{t-1} - \mu) - 0.5(X_{t-2} - \mu) + e_t$$
6. a) What is spectral analysis? How is it done? Explain with relevant equations. [2+6]  
b) The  $\bar{X}$ ,  $s_x$ ,  $r_1$ ,  $r_2$  of the observed annual flows of a stream are estimated as 875 Mm<sup>3</sup>, 262 Mm<sup>3</sup>, 0.8 and 0.46 respectively. Generate a sequence of 3 annual flows assuming that the flows are normally distributed and taking the chain of three uniform random number as 0.3781, 0.63702, 0.98343. Use AR(2) model. [11]
7. Obtain 2 normal random numbers from the sequence of following uniform random numbers using central limit theorem method. [6]  
0.637, 0.301, 0.386, 0.988, 0.855, 0.023, 0.351, 0.949, 0.665, 0.705, 0.376, 0.435
8. Explain the following: [9]  
Method of maximum likelihood for estimation of parameters, test of assumptions of AR models and Parsimony of parameters.

10 / 15 D.

06D TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2071 Magh

Exam.	New Back (2066 & Later Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject:** - Environmental Impact Assessment (*Elective III*) (CE78504)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) The term climate change and sustainable development is burning issues these days. Explain how EIA has come forward as an effective tool to tackle these issues. [8]  
b) Differentiate between IEE and EIA. What are the major environment screening criteria in Nepal? [3+5]
2. a) Give proper linkage of EIA and project cycle. List out the different aims of environmental scoping. [5+3]  
b) What is the objectives of scoping in EIA process. How do you prepare TOR for EIA process briefly describe with an example. [8]
3. a) What is the purpose of baseline studies? Describe about environmental setting for baseline studies. [4+4]  
b) A cement factory burns 5 tonnes of coal per hour and discharge the combustion products through a stack having a physical height of 75 m. Predict the impact of SO<sub>2</sub> emission on environment at 1000 m downwind and at a lateral distance of 400 m on either side of plume from chimney. Note that sulfur content on coal is 4%. Wind speed at top of the chimney is 6 m/sec. Atmospheric pressure is 1000 mb. Inside diameter of chimney is 0.9 m. Stack gas exit velocity 12 m/sec. Stack gas exit temperature and air temperature are 140°C and 25°C respectively. Take  $\sigma_y = 120$  m and  $\sigma_z = 85$  m. [8]
4. a) Discuss the impact evaluation technique. A largely poorly controlled brick factory has a stack 75 m high, it is currently emitting 127 g/s of SO<sub>2</sub>. Estimate the ground level concentration of SO<sub>2</sub> from this sources at a distance 3 KM directly downwind when the wind speed is 6 m/s at top of stack and the stability class is C (Take horizontal dispersion and vertical dispersion coefficient is 280 m and 170 m respectively). [8]  
b) What is EMP? Highlight the objective of environmental monitoring. What are the different types of monitoring carried out in EIA? [2+2+4]
5. a) Explain different types of environment protection measures (EPMs). [8]  
b) It is said that 'The beauty of EIA is public participation'. Explain the statement. Who are stakeholders involved in EIA process? [4+4]
6. Write short notes on: [4×4]
  - a) Method of impact evaluation techniques
  - b) Environmental Auditing
  - c) EIA Review
  - d) Project Cycle of EIA

06C TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2070 Chitra

Exam.	Old Back (2065 & Earlier Batch)		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Environmental Impact Assessment (EG735CE) (Elective I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Eight** questions.
- ✓ **All** questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Describe how EIA process it is linked with the project life cycle with suitable example of new hospital construction project.
2. Explain the various steps involved in Initial Environmental Examination of a bridge project of 18 m long.
3. Explain the process for scoping exercise in brief when you are selected as a team leader for EIA of hydropower project of 50 MW.
4. What do you understand by base line information? Explain methods of collecting the baseline data for road in hill areas.
5. State and discuss different methods of impact prediction and compare them briefly.
6. The sewage of Pokhara municipality area is to be discharged in to Seti river. The quality of sewage produced per day is 2 million litters having BOD is 250mg/l. If the discharge in the river is 225l/s and its BOD is 10 mg/l. Find BOD of resulting mixture. Determine quantity of sewage that can be safely discharge in Seti, if it is desired not to give permission to raise BOD more than 5 mg/l in Seti River?
7. Define mitigation measures. Describe various types of mitigation measures to be adopted with suitable examples from a road construction project in hill area.
8. Explain briefly the various activities involved in report review and decision making process. Also mention various auditing parameters used for a water supply project.
9. Describe benefits and flaws of public involvement in EIA process. Discuss difficulties and constraints in public involvement and stakeholder consultation.

\*\*\*

Exam.	Regular / Back •		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject:** - Environmental Impact Assessment (EG785CE) (Elective II)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a. Explain about the types of impacts in the environment with examples due to execution of projects. (8)  
b. How do you link between the project cycle and EIA? Illustrate. (8)
2. a. Assume that a housing project is being planned in your locality. What types of baseline information do you need to collect? Enlist the major environmental parameters of the project area for which baseline information require to be assessed. (4+4)  
b. What type of environmental assessment is needed (as per EPR) for a hydropower project of installed capacity of 6 Mega watts? Differentiate between IEE and EIA. (3+5)
3. a. Mention the content of public notice during scoping in Environmental Assessment. Enlist the components of TOR. (3+5)  
b. Define screening process. Describe its importance and criteria. (8)
4. a. State various methods of impact prediction and discuss briefly any three methods. (2+6)  
b. Describe about the *Environmental Evaluation System* (EES) with examples. (8)
5. a. Why public participation is one key factor during EIA? How is it conducted? (4+4)  
b. Describe about the Environmental Monitoring with its process and stages. (8)
6. a. A factory burns 4 tons of coal/hr and discharges the combustion products through a stack with effective height of 80 m. The coal contains sulfur content of 5.5%, and the wind velocity at the top of stack is 7.5 m/s. The atmospheric conditions are moderately to slightly unstable. Consider  $\sigma_y$  and  $\sigma_z$  as 220m and 185 m respectively. Predict maximum G.L. concentration of SO<sub>2</sub> at 1500 m downwind and 600 m crosswind direction. (8)  
b. Write short notes on any two. (4x2)
  - i. EIA Review
  - ii. Environmental Protection Rules
  - iii. Scoping in EIA

61 TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2068 Chaitra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject:** - Environmental Impact Assessment (*Elective I*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Define EIA. Describe the function and limitation of EIA in brief. [2+6]  
b) Differentiate between IEE and EIA process on the basis of their objectives and Nepalese legal process. [8]
2. a) What are the methods of analyzing alternative proposals? Also, illustrate about unranked paired comparison technique, both simple and complex. [8]  
b) Describe about the methods of impact prediction, and also discuss about methods of impact identification with suitable examples. [8]
3. a) Describe the objectives of environmental monitoring. What are the types of monitoring carried out in EIA? [8]  
b) What is environmental auditing? Describe the various activities involved in auditing. [8]
4. a) A proposed paper processing mill is expected to emit ½ tonne of H<sub>2</sub>S per day from a single stack. The nearest receptor is a small town 1700m northeast of the mill site and the southwest wind is expected to occur 15% of the time. The stake at the mill must be sufficiently high so that H<sub>2</sub>S concentration in the town will not exceed 28 µg/m<sup>3</sup> on mass basis at the ground. The physical characteristics of the emission and the ambient atmosphere are: Gas exit velocity = 20m/sec, Gas exit temperature = 122°C, Stack diameter at the top = 2.5m, Ambient air temperature = 17°C, mean wind velocity = 2m/sec, Take σ<sub>y</sub> = 80m, σ<sub>z</sub> = 30m and the atmosphere is slightly stable. Determine the ground level concentration at the point, downwind distance, 1700m and crosswind distance = 500m. [10]  
b) What are the basic principle of public involvement in EIA process? Discuss, in brief, about types of public involvement in EIA process and its needs too. [6]
5. a) State and explain the types of the mitigation measures that have been brought in practice in EIA and also illustrate about mitigation measures hierarchy. [8]  
b) Explain the importance of scoping and TOR. Also explain the main content of EIA report. [8]
6. Write short notes on: (any four) [4×4]
  - a) Environmental Management plan
  - b) Base line data
  - c) Evolution of EIA
  - d) Direct and indirect impacts of land clearing and road construction activities
  - e) Geographical study area for EIA study.

\*\*\*

02B TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2068 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject:** - Environmental Impact Assessment (*Elective II*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) What are the major functions and benefits of EIA? Describe the various steps involved in EIA process. (3+5)
- b) Write short notes on (i) Selection of geographical study area for EIA and (ii) Linkage of EIA and Project cycle (4+4)
2. a) Define scoping process. Describe the steps involved in carrying out a scoping exercise. (2+6)
- b) Illustrate the meaning of baseline information. Describe its importance, purpose & list the various physical and socio-economic information that needs to be collected for a new project. (2+6)
3. a) Define environmental impact. Describe physical, biological and socioeconomic impacts. (2+4)
- b) A brick factory burns 15 tonnes of coal per hour & discharges the combustion products through a stack having an effective height of 85 m. Predict the impact of SO<sub>2</sub> emission on environment at 1000 m downwind & at a crosswind distance of 400 m from the chimney. (Note: SO<sub>2</sub> concentration over 120 µg/m<sup>3</sup> will increase the risk of bronchitis to human receptors.) Take following data:  
Sulphur content of coal: 6 %, Wind speed at top of chimney: 5 m/sec,  $\sigma_y = 175$  m and  $\sigma_z = 120$  m. (10)
4. (a) Describe the importance of impact identification in EIA process. State various methods of impact identification and describe one method which is most appropriate for Nepal. (2+4)
- (b) A new factory is to be located near a stream flowing through an urban area. The characteristics of the stream & factory wastewater are as follows:

Items	Stream	Wastewater
Flow, m <sup>3</sup> /sec	6	2
DO, mg/l	6	4
Temperature, °C	22	32
BOD <sub>5</sub> at 20°C, mg/l	4	225
Take $K_{1-20}$ (base 10) = 0.25 per day, $K_{2-20}$ (base 10) = 0.45 per day, $\Theta_1 = 1.05$ & $\Theta_2 = 1.02$ , Saturation DO at 20 and 30°C are 9.17 & 7.63 mg/l respectively.		

Predict the allowable BOD<sub>5</sub> value of the wastewater that should be permitted to be discharged in the stream so that a minimum DO of 5 mg/l could be maintained. (10)

5. (a) What do you understand by environmental protection measures? Mention the hierarchy of environmental protection measures and write about the types of environmental protection measures considered in EIA. (2+1+5)
- (b) Describe the types of environmental audits. What are the activities involved in an auditing process? Explain. (4+4)
6. Compare the followings: (4x4)
  - (a) Direct and indirect impacts
  - (b) Magnitude and Extent of impacts
  - (c) Checklist method & Leopold Matrix method
  - (d) Project level EIA & Legislative EIA

\*\*\*

061 . TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2068 Baishakh

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

***Subject: - Environmental Impact Assessment (Elective)***

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any ***Five*** questions.
- ✓ The figures in the margin indicate ***Full Marks***.
- ✓ Assume suitable data if necessary.

1. a) Describe the role of project level EIA in achieving sustainable development and its linkage with project cycle. [8]  
b) Describe briefly about the objectives and the importance of ToR and scoping in EIA process.
2. a) Explain the importance of baseline data collection in EIA, and also discuss about the impact identification methods. [8]  
b) Discuss about the type of impacts and importance of impact prediction, and also describe briefly the methods used in impact prediction. [8]
3. a) Define Environmental management action plan (EMAP). List out the principles and procedure to be followed while preparing EMAP. [8]  
b) What are the basic principle of public involvement in EIA process? Discuss in brief about type of public involvement in EIA process and its need too. [8]
4. a) A thermal plant power burns coal at the rate of 10 tons/hr and discharges the combustion products through a chimney having effective height of 100m. The coal has sulphur content of 10%, the wind velocity at the top of the stack is 7m/sec and the atmospheric condition is slightly unstable. Determine the GL concentration of SO<sub>2</sub> at a downward distance of 120m and at a crosswind distance of 250m. Take  $\sigma_y = 110m$ ,  $\sigma_z = 70m$ . Also determine the GL concentration in horizontal direction. [8]  
b) Explain why impact evaluation is essential in EIA process, and also describe briefly about the methods to be used while carrying out comparative analysis. [8]
5. a) State and explain the types of mitigation measures in practice in EIA. [8]  
b) 100 cumecs of sewage of a city is discharged in a perennial river which is fully saturated with oxygen and flows at a minimum rate of 1250 cumecs with a minimum velocity of 0.15m/sec. If the 5 day BOD of the sewage is 260mg/lit, find out where the critical DO will occur in the river. Assume:  
i) The coefficient of purification of river as 0.4  
ii) Coefficient of DO as 0.11 and  
iii) The ultimate BOD as 125% of the 5 day BOD of the mixture of sewage and the river water. What should be the allowable BOD of sewage if a minimum DO of 5 mg/l is to be maintained in the river? [8]
6. Write short notes on:(any four) [4×4]  
a) EIA process  
b) Screening criteria  
c) Evolution of EIA  
d) Environmental monitoring and its type  
e) Environmental auditing and its type

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Environmental Impact Assessment (Elective II)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. (a) EIA has emerged as an effective tool for project planning and appraisal. Discuss this statement. (8)
- (b) Write a note on (i) Environmental impact and its type and (ii) Types of EIA (5+3)
2. (a) "Scoping process is an important part of EIA process". Describe this statement highlighting scoping's objectives. (8)
- (b) State the different methods of impact identification. Describe any two methods of impact identification. (8)
3. (a) Differentiate IEE and EIA process on the basis of their objectives and Nepalese legal process. (6)
- (b) 155 gm/cc of SO<sub>2</sub> is likely to be emitted from a new proposed industry close to a suburban area in Kathmandu valley. The wind speed in a winter morning is 6 m/sec. The effective height of the chimney emitting the flue gases is 55 m. Predict the ground level concentration of SO<sub>2</sub> at a downwind distance of 500 m from the chimney using Gaussian Plume Model. The value of  $\sigma_y$  and  $\sigma_z$  at this distance are 37 m and 19 m respectively. (10)
4. (a) Describe the conceptual approach of predicting impact on surface water environment. (8)
- (b) State and explain various types of mitigation measures. (8)
5. (a) Define auditing and briefly write about types of auditing in EIA. (4)
- (b) A new industry is proposed near a stream flowing through a city. The characteristics of the stream & industrial wastewater are given below:

Items	Stream	Wastewater
Flow, m <sup>3</sup> /sec	12	8
DO, mg/l	5	2.5
Temperature, °C	20	30
BOD <sub>5</sub> at 20°C, mg/l	3.5	265
Take $K_{1-20}$ (base 10) = 0.27 per day, $K_{2-20}$ (base 10) = 0.43 per day, $\Theta_1 = 1.047$ & $\Theta_2 = 1.016$ , Saturation DO at 20° C and 25°C are 9.17 & 8.38 mg/l respectively.		

Predict the allowable BOD<sub>5</sub> value of the wastewater that should be permitted to be discharged in the stream so that a minimum DO of 5 mg/l could be maintained. (12)

6. Write short notes on: (any four) (4x4)
  - a) Geographical study area for EIA study
  - b) Types of monitoring
  - c) Methods of Public participation
  - d) Environmental management plan
  - e) Screening criteria

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Environmental Impact Assessment (Elective I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Write a note on political awakening and emergence of EIA. Also describe the benefits and functions of EIA. [8]  
b) Define screening process. Describe objectives of screening and criteria used for screening. [8]
2. a) What do you understand by scoping process? Describe the objectives of scoping and activities that you carry out during scoping exercise. [10]  
b) What is baseline information? Describe the purpose and method of baseline data collection in EIA. [6]
3. a) Compare between the checklist and matrix method of impact identification. Which method would you prefer? Explain. [8]  
b) A settlement is at a distance of 1000m from a proposed site of brick factory. It consumes 120 tonnes of coal per hour and discharges the combustion products through a chimney of effective height of 95m. The sulfur content of the coal is 4%. Predict the ground level concentration of SO<sub>2</sub> in and around the settlement. The horizontal ( $\sigma_y$ ) and vertical ( $\sigma_z$ ) plume standard deviation at 1000m downwind direction is 120m and 75m respectively. The wind speed at the top of the chimney is 4 m/sec. If the recommended ambient SO<sub>2</sub> concentration is 150 µg/m<sup>3</sup>, will there be any impact on the health of people. [8]
4. a) Define mitigation measures. Describe their objectives and the types of mitigation measures generally considered for new development projects. [8]  
b) Explain the various sources of air pollution. Describe the conceptual approach of predicting impact on air environment. [8]
5. a) Define environmental monitoring. What are the objectives of monitoring? Explain types of monitoring and activities carried out in monitoring. [10]  
b) A paint factory is proposed to be constructed near a relatively clean river flowing through a city. The average daily flow from the factory is 50m<sup>3</sup>/day and the average concentration of C<sub>r</sub> in the wastewater is expected to be around 25 mg/l. The C<sub>r</sub> concentration in the river is 0.6 mg/l and flow rate of river is 3500 m<sup>3</sup>/day. What would be the average concentration of C<sub>r</sub> in the downstream of the proposed site? [6]
6. Write short notes (any four): [4×4]
  - a) Geographical Study Area
  - b) Public Participation
  - c) TOR and its main components
  - d) Environmental Auditing
  - e) Types of impacts

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject:** - Environmental Impact Assessment (*Elective*)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ **All** questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. a) Explain different types of EIA. What are the functions of EIA?  
b) Write a note on (i) geographical study area and (ii) time frame, budget and organization and personnel involved in EIA.
2. a) What are the various environmental impacts to be considered in EIA? Explain biological impact.  
b) Why scoping exercise is necessary in EIA study? Explain. Describe the steps involved in scoping process.
3. a) What do you understand by baseline information in EIA? What are the major environmental parameters of the project area for which baseline information required to be assessed?  
b) A brick factory is proposed near a settlement which is situated at a 900m downwind direction. The factory consumes 225 tonnes of coal per hour having sulphur content of 5%. The effective height of the chimney is 85m. Predict the ground level concentration of SO<sub>2</sub> in and around the settlement. The horizontal ( $\sigma_y$ ) and vertical ( $\sigma_z$ ) plume standard deviation is 95 and 150 respectively. Will there be any significant health impact to the residents if the recommended concentration of SO<sub>2</sub> is 200 mg/m<sup>3</sup>. Take  $\bar{u} = 6$  m/sec.
4. a) What do you understand by magnitude, extent and duration in relation to impact prediction? State various types of prediction methods and explain expert judgment method.  
b) Define mitigation measures. Explain various types of mitigation measures considered in EIA.
5. a) What do you understand by TOR in EIA? Explain its objects and main components.  
b) Define Environmental Management Plan. What are the aims of EMP? Describe the composition and responsibilities of construction phase environmental management team.
6. Compare the following:
  - a) Strategic EIA and Supplemental EIA
  - b) Social impact and Cultural impact
  - c) Checklist method and Ad-hoc method
  - d) Baseline monitoring and Impact monitoring
7. Write short notes on:
  - a) Screening Criteria
  - b) Public Participation
  - c) Auditing Process
  - d) EIA

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Environmental Impact Assessment (Elective)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Explain how EIA has emerged as an effective tool for project planning and selection. [8]  
b) Explain the various stages involved in carrying out EIA of a new project. [8]
2. a) Describe how EIA process is closely linked with the project life cycle. [8]  
b) What do you understand by IEE process? Explain the methods used for IEE study. [8]
3. a) A tanning factory is proposed near a relatively clean river. The characteristics of the river and wastewater discharge are as given below: [11]

Items	Unit	River	Wastewater
Flow	m <sup>3</sup> /s	5	3
DO	mg/l	8	2
Temperature	°C	33	20
BOD <sub>5</sub> at 20°C	mg/l	450	3

Minimum DO to be maintained in the river is 5 mg/l. Assume  $K_{1-20} = 0.15 \text{ days}^{-1}$  and  $K_{2-20} = 0.33 \text{ days}^{-1}$ ,  $\theta_1 = 1.047$ ,  $\theta_2 = 1.016$ . Estimate the maximum BOD<sub>5</sub> value of the wastewater from the factory that should be allowed to be discharged in the river. Saturation value of DO at 25°C and 30°C are 8.38 mg/l and 7.63 mg/l respectively.

- b) What do you understand by geographical study area of EIA? Describe the various criteria used to select the study area. [5]
4. a) Describe the importance of impact identification in EIA process. State the different methods used for impact identification and describe impact summary matrix method. [8]  
b) Define environmental monitoring. Describe the types of monitoring to be carried out during a project life cycle. [8]
5. a) Describe the various components of an Environmental Management Plan. Also mention the formation of operation phase environmental management team and its responsibilities. [8]  
b) What do you understand by environmental auditing? Describe types of audits and auditing procedure to be adopted. [8]
6. Compare the following: [4×4]
  - a) Physical impact and Biological impact
  - b) Network method and Matrix method
  - c) Predictive technique audit and Project impact audit
7. Write short notes on: [4×4]
  - a) Environmental prediction in Nepal
  - b) Impact prediction methods
  - c) Public participation in EIA
  - d) Baseline Data Collection

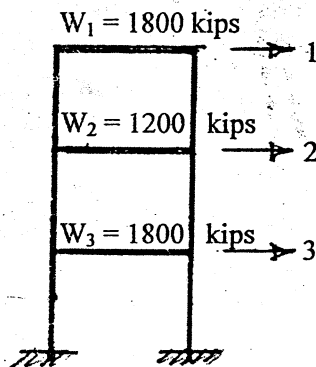
30 copies  
2071-02-3

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject:** - Earthquake Resistant Design of Structure (*Elective II*) (CE76501)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Four** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Use of I.S. 1893 (Part 1) - 2002 is allowed.
- ✓ Use proper and consistent unit system.
- ✓ Assume suitable data if necessary.

- Write down the Gutenberg-Richter Recurrence law. What would be the mean annual rate of exceedence of earthquake of magnitude  $M_{4.5}$ , for a fault with the values given:  $a = 5.2$  and  $b = 1.0$ . [5]
  - How the Probabilistic Seismic Hazard Analysis (PSHA) is different from the Deterministic Seismic Hazard Analysis (DSHA)? [5]
  - What would be the return period for the 2% probability of exceedence in 50 years, and 2% probability of exceedence in 500 years? [4]
  - Find the seismic moment ( $M_0$ ) of a moment magnitude  $M_w = 7.5$  of earthquake. [6]
- What are the principal ground motion parameters? Describe in brief how they are determined or represented. [6]
  - What is response spectrum? Write down the relationships between Duhamel Integral and different forms of structural responses due to ground motion. [8]
  - Write down the relationship between energy released and the magnitude of an earthquake. Illustrate the increase in energy due to increase in magnitude. [6]
- A 3-storey shear frame is shown in figure below with the indicated lumped weights. Assume the following mode shape matrix and modal frequencies as the result of the free vibration analysis. If the pseudo-velocity response corresponding to the modal frequencies (natural time periods correspondingly) is as given below: [20]
  - Determine the base shear for each mode by using the design response spectrum.
  - Determine the lateral load at each level for each mode.
  - Determine the base shear due to all modes using SRSS method.



$$[\phi] = \begin{bmatrix} 1.000 & 1.000 & 1.000 \\ 0.681 & -2.380 & -4.160 \\ 0.350 & -1.522 & 2.584 \end{bmatrix}$$

$$\{\omega\} = \begin{Bmatrix} 15.5 \\ 38.5 \\ 61.7 \end{Bmatrix} \text{ rad/sec}$$

$$\text{Pseudo-velocity response: } \{S_v\} = \begin{Bmatrix} 25 \\ 9 \\ 5 \end{Bmatrix} \text{ inch/sec.}$$

$$\text{earthquake response integrals for the three modes are } \{v(t)\} = \begin{Bmatrix} -0.50 \\ 0.75 \end{Bmatrix}$$

4. a) Describe in a stepwise procedure how to determine the lateral seismic loads on a building to be designed using seismic coefficient method using IS 1893 : (Part 1) - 2002. You may give an example without parametric calculations.
- b) The figure given below shows the plan of an one-storey building which could be considered as composed of 2-D frames along the orthogonal directions. The roof diaphragm is rigid in its own plane, and the mass of the roof is uniformly distributed. The building is subjected to a lateral load of 600 KN, due to earthquake, in y-direction and passing through the center of mass of the building. Calculate the lateral forces in the 2-D frames along X and Y directions.

[12]

Candidate Attempt  
The fig  
Use of  
Use pr  
Assum

[8]

a) Li  
is

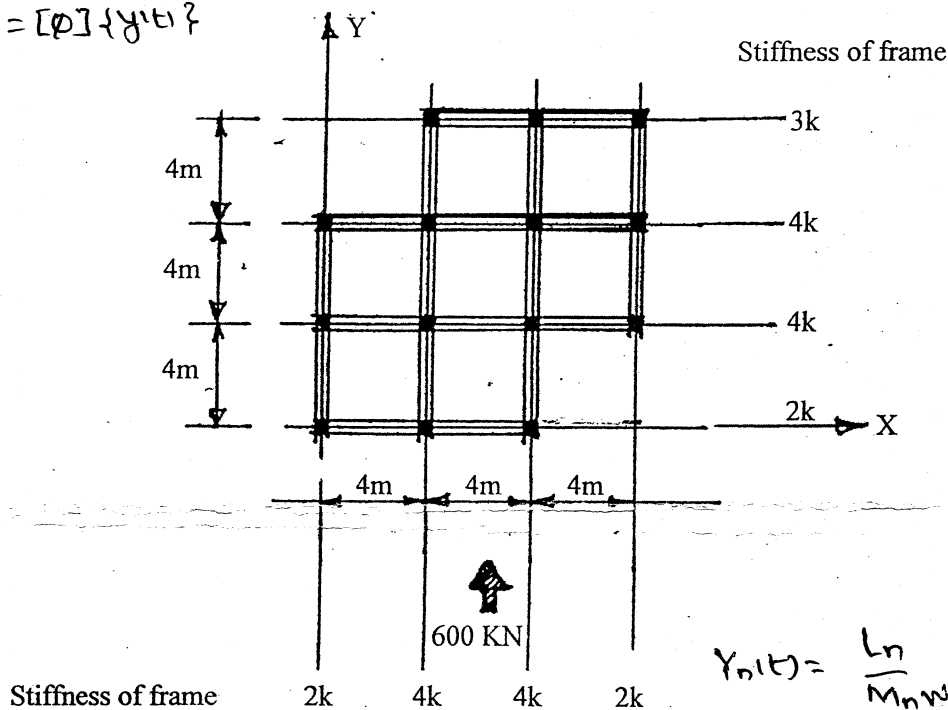
b) Na

c) Fi  
na  
a:

a) W  
dy

b) A  
pr

$$\{u(t)\} = [\phi] \{y(t)\}$$



$$Y_n(t) = \frac{L_n}{M_n \omega_n} \{y(t)\}$$

$$\{u(t)\} = [\phi] \{y(t)\}$$

$$f_n(t) = [m] [\phi] \left\{ \frac{L_n \omega_n^2 y(t)}{M_n [4 \times 5]} \right\}$$

Each mod

$$f_n(t) = [m] [\phi] \left\{ \frac{L_n \omega_n^2 y(t)}{M_n} \right\}$$

5. Write short notes on: (any four)
- Torsionally coupled systems
  - Response spectrum analysis for earthquakes
  - Approximate lateral load analysis of frames
  - Shear wall and lateral stiffness
  - Seismic waves
  - Seismic hazard curves

\*\*\*

3. A fi  
buil  
stor  
des:  
frar  
in s  
are  
dea  
111  
sub  
the  
roc  
det  
str

Exam.	Level	Programme	Year / Part	Roll No. / Back	Full Marks	Pass Marks	Time
	BE	BCE	IV / II		80	32	3 hrs.

**Subject:** - Fundamentals of Earthquake Engineering (EG785CE) (Elective II)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Four** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Use proper and consistent unit system.
- ✓ Use of I.S.1893 (part 1)-2002 is allowed.
- ✓ Assume suitable data if necessary.

1. a) What is plate tectonics? Explain in brief the Elastic Rebound Theory. [4]
- b) A maximum trace amplitude of 390mm is recorded by a standard Wood Anderson seismograph that has a natural period of 0.8 second, a damping factors of 80% and a magnification factor of 2800; the seismograph was located on firm ground at a distance of exactly 100Km from the epicenter of the earthquake. Based on these assumption, determine the Richter Magnitude. What would be the Richter Magnitude if the amplitude is 9300mm? [8]
- c) During a major earthquake, the depth of fault rupture is estimated to be 20Km, the length of surface faulting is determined to be 450 Km, and the average slip along the fault is 2.4. Based on these assumptions, determine the seismic moment and the moment magnitude of the earthquake. Use shear modulus equal to  $3.125 \times 10^{10} \text{ N/m}^2$ . [8]
2. a) What is a fault? Describe with neat sketches different types of faults. [6]
- b) What are seismic waves? Write the salient features of different types of seismic wave. What are the approximate typical velocities of these waves? [6]
- c) Using a deterministic Seismic Hazard Analysis, Compute the Peak Ground Acceleration (PGA) at the site shown in the figure below. The site is located in the vicinity of 3 independent seismic sources, the locations of which with respect to the site are also shown in the figure. The maximum magnitudes of the earthquakes that have occurred in the past for the sources are recorded as: [8]

Source	Maximum Magnitude
1	7.5
2	6.8
3	6.0

It is assumed that the attenuation relationship given by cornel et al., given below is valid for the region.

$\ln \text{PGA (gal)} = 6.74 + 0.859M - 1.80 \ln(r+25)$  where  $r$  is the epicentral distance in kilometers and  $M$  is the magnitude of earthquake.

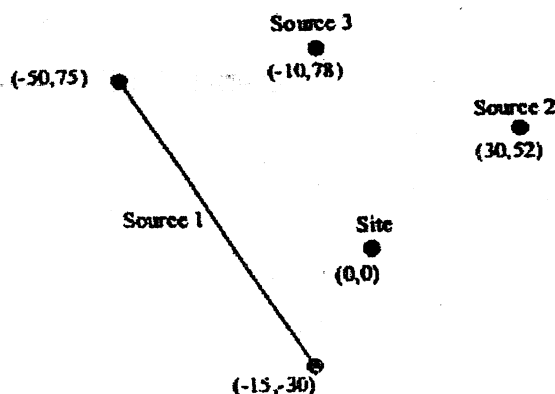


Figure 1: Sources of earthquake near the site

3. A 2-storey shear frame is shown in figure below with the indicated lumped masses and storey stiffnesses. The acceleration response spectrum given in figure 3 is applicable to the frame. Determine, for the frame:

[20]

- The maximum displacement distribution under the acceleration spectrum,
- Modal force vectors, and
- Modal base shear forces

Also calculate

- The modal participation factors,
- The effective modal masses and
- The total maximum base shear by SRSS method.

The results of eigenvalue (free-vibration) analysis are also given below.

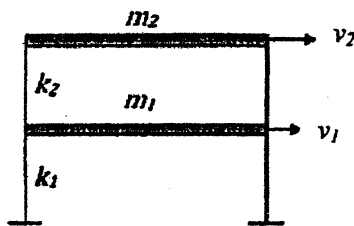


Fig. 2

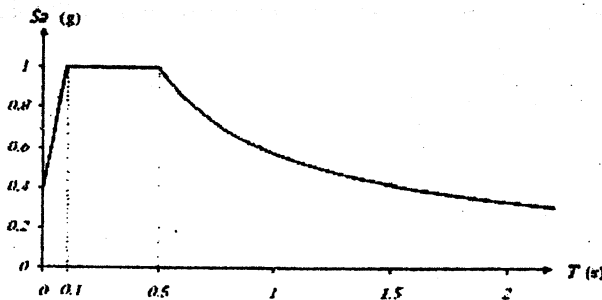


Fig. 3

$$k_1 = k_2 = k = 4 \times 10^6 \text{ N/m}$$

$$m_1 = 5000 \text{ kg;}$$

$$m_2 = 3000 \text{ kg.}$$

$$\{\phi_1\} = \begin{Bmatrix} 1 \\ 1.468 \end{Bmatrix}$$

$$\{\phi_2\} = \begin{Bmatrix} 1 \\ -1.135 \end{Bmatrix}$$

$$\omega_1 = 20.6 \text{ rad/sec}$$

$$\omega_2 = 50.1 \text{ rad/sec}$$

$$T_1 = 0.305 \text{ sec}$$

$$T_2 = 0.125 \text{ sec}$$

4. a) Determine the design horizontal seismic coefficient for a special reinforced concrete moment resisting frame (SMRF) hospital building without infill panels for a damping of 5%. The building is situated in seismic zone V according to IS 1893 (part 1) 2002. The height of the building is 19m and it is resting on soft soil. Also write down the expressions for the base shear and the vertical distribution of the base shear.

[6]

- b) The figure given below (figure 4) shows the plan of an one-storey building which could be considered as composed of 2-D frames along the orthogonal directions. The roof diaphragm is rigid in its own plane, and the mass of the roof is uniformly distributed. The building is subjected to a lateral load of 1200 KN, due to earthquake, in y-direction and passing through the center of mass of the building. Calculate the lateral forces in the 2-D frames along X as well as Y directions.

[14]

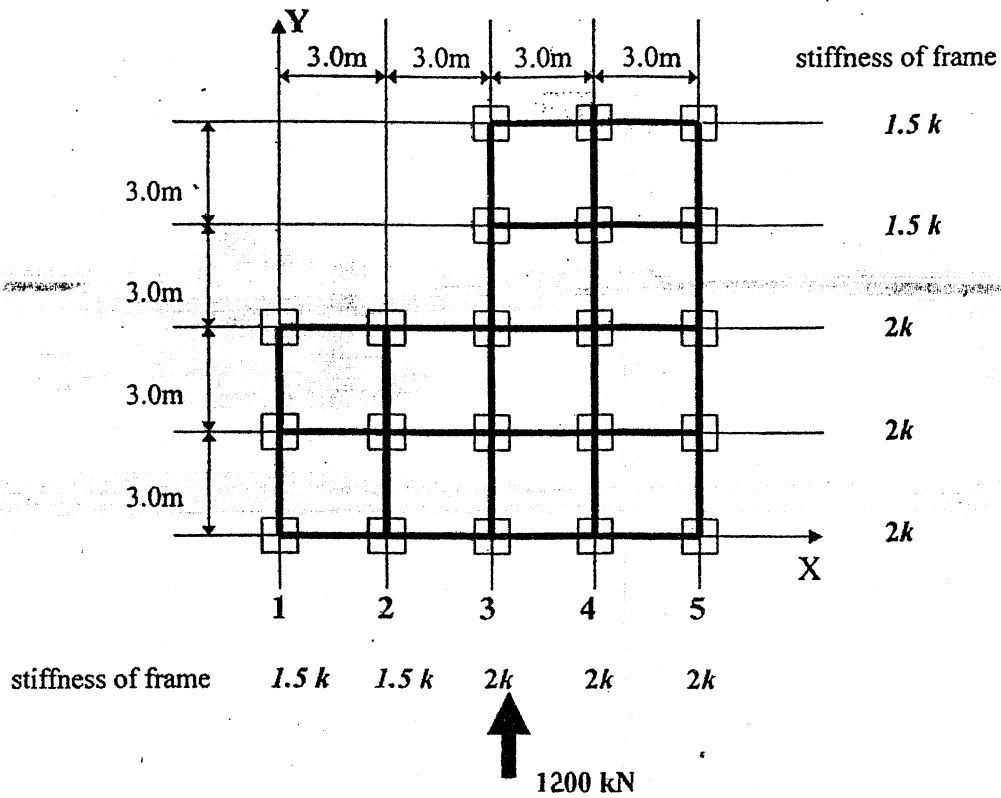


Figure 4: Plan of the building

5. Write short notes on: (any four)

[4×5]

- Factors influencing ground motion parameters at a site.
- Center of mass, center of rigidity and torsionally coupled system
- Lateral stiffness of a solid shear wall
- Failure mechanism of reinforced concrete frames
- Ductile detailing of reinforced concrete frames
- Response reduction factors

\*\*\*

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject:** - Fundamentals of Earthquake Engineering (Elective II)

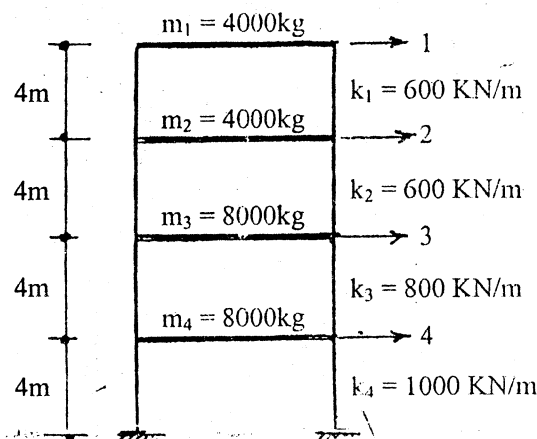
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Four** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Use of IS 1893 (Part I) - 2002 is allowed.
- ✓ Use proper and consistent unit system.
- ✓ Assume suitable data if necessary.

1. a) List the main hazards due to an earthquake. Explain the tectonic theory of earthquake. Why a seismic hazard analysis is carried out for a site? [3+3+2]  
 b) Write down the principal components of a Deterministic Seismic Hazard Analysis with necessary sketches and explanations. [8]  
 c) Find the spectral pseudo-velocity and spectral acceleration of a structure, which has a natural frequency of vibration 3 Hz and a damping ratio of  $\xi = 0.05$ , corresponding to a spectral displacement of 0.0276m. [4]
2. For the building frame shown in the figure below, the vibration properties, and the acceleration response spectrum values for the four modes are as given below: [20]

$$[k] = \begin{bmatrix} 600 & -600 & 0 & 0 \\ -600 & 1200 & -600 & 0 \\ 0 & -600 & 1400 & -800 \\ 0 & 0 & -800 & 1800 \end{bmatrix} \text{ KN/m; } \{W_n\} = \begin{Bmatrix} 4.50 \\ 10.62 \\ 16.85 \\ 20.81 \end{Bmatrix} \text{ rad/sec}$$

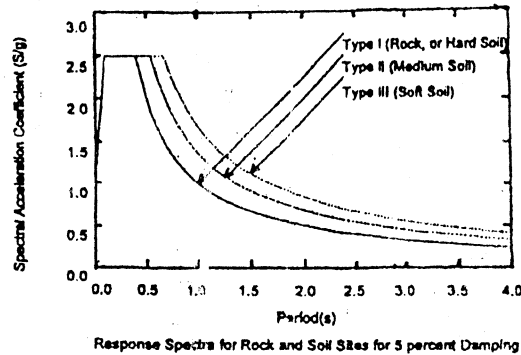
$$[\Phi] = \begin{bmatrix} 1.000 & 1.000 & 1.000 & 1.000 \\ 0.8645 & 0.2478 & -0.8925 & -1.8870 \\ 0.6126 & -0.6905 & -1.0961 & 9.6740 \\ 0.2991 & -0.6156 & 1.8625 & -0.3741 \end{bmatrix}; \{S_{a,n}\} = \begin{Bmatrix} 0.1687 \\ 0.3973 \\ 0.5886 \\ 0.5886 \end{Bmatrix} \text{ m/sec}^2$$

Calculate, for each mode of vibration, the maximum displacement, shear force and overturning moment at each storey level. Also determine approximate total maximums for each of these response quantities.



3. a) What are the limitations for use of seismic coefficient method in the design of a multi-storeyed building? What is the code provision for the storey drift? [3+2]

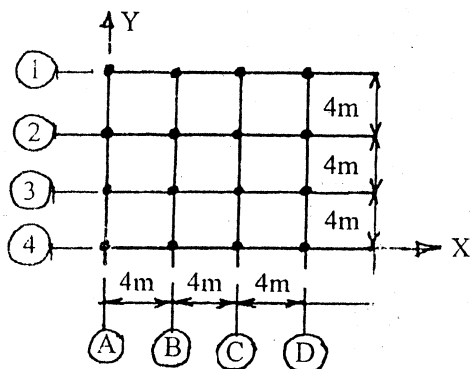
- b) A three-storey reinforced concrete public building with a total height of 12m and a storey height of 4m each, has to be designed in Special Moment Resisting Frame. The proposed building is located in seismic zone V and the soil conditions are medium. The lumped weight due to dead loads is  $10 \text{ KN/m}^2$  on floors and  $12 \text{ KN/m}^2$  on roof. The floors are subjected to a live load of  $5 \text{ KN/m}^2$  and the roof to  $4 \text{ KN/m}^2$ . If the floors and roof at each level have area of  $300 \text{ m}^2$ , determine design seismic load on the structure as per IS : 1893 (Part 1) - 2002. Take zone factor  $Z = 0.36$  and importance factor  $I = 1.0$ . The fundamental natural period of vibration ( $T_a$ ) in seconds may be estimated by the expression:  $T_a = 0.075 h^{0.75}$ , where  $h$  is the height of the building in meter. Use the response spectra as shown in the figure below. [15]



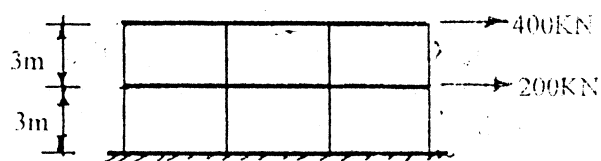
4. a) A two-storey building, shown in the figure below, is subjected to the design earthquake load in X-direction with 400kN at the roof and 200kN at the first floor. The building could be considered as composed of 2-D frames along the orthogonal directions. The roof and floor provide rigid diaphragm action, and the mass of the roof and the floor is uniformly distributed. The lateral stiffness matrices for the frames in X-direction are: [14]

$$[k]_1 = [k]_4 = \begin{bmatrix} 100 & -40 \\ -40 & 35 \end{bmatrix} \times 10^6 \text{ N/m}; \quad [k]_2 = [k]_3 = \begin{bmatrix} 80 & -30 \\ -30 & 25 \end{bmatrix} \times 10^6 \text{ N/m}$$

Carry out an exact lateral load distribution and find out the design lateral forces in the frames.



Plan



Elevation

- b) Obtain the bending moment diagram from Frame 2 of the above figure (Question # 4(a)) using the cantilever method. Use the lateral force determined from the above problem for the analysis of the frame. [6]
5. Write short notes on: (any four) [4x5]
- Principles of seismic design
  - Duhamel integral, earthquake response integral and response spectrum
  - Lateral stiffness of a solid shear wall
  - Torsionally coupled system
  - Behaviour of brick masonry walls on lateral loads
  - Ductile detailing of reinforced concrete frames

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

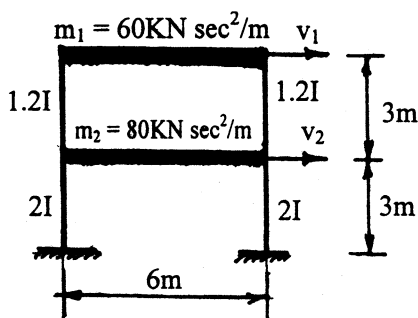
**Subject:** - Fundamentals of Earthquake Engineering (Elective)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Use of IS 1893 (Part 1) - 2002 is allowed.
- ✓ Assume suitable data if necessary.

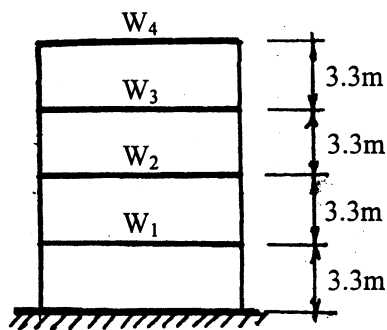
1. a) Define magnitude of an earthquake, as given by Richter. What is moment magnitude, and how is it different from local magnitude (Richter)? What is the difference in energy released due to earthquakes of magnitude 6 and 7? [2+3+2]
- b) Describe in brief elastic rebound theory. What is the mechanism of earthquake? List the types of faults. Describe different types of seismic waves in terms of their propagation speed. [2+3+3+5]
2. a) What is response spectrum? Find the spectral displacement and spectral pseudo-velocity of a structure, which has a natural frequency of vibration of 2Hz and a damping ratio of  $\xi = 0.03$ , corresponding to a spectral acceleration of  $S_a = 12.57 \text{ m/sec}^2$ . [2+3]
- b) The acceleration response spectrum values for a two-storey shear building, as shown in the figure below, are given as [15]

$$S_a = \begin{Bmatrix} 0.586 \\ 0.925 \end{Bmatrix} \text{m/s}^2$$

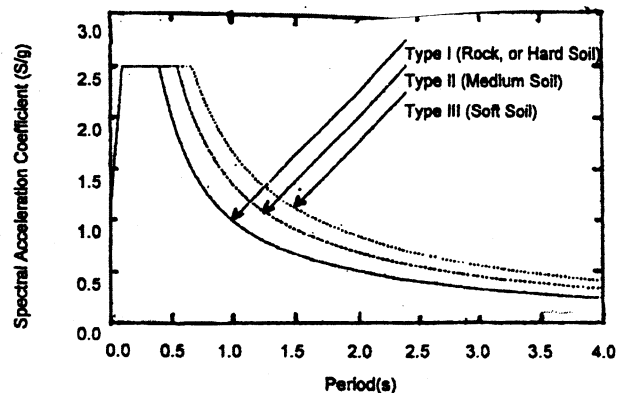
Calculate for each mode of vibration, the maximum displacement, shear force and overturning moment at each storey level. Also determine total maximums for each of the response quantities of the above.



3. A four-storey reinforced concrete public building, idealized version of which is shown in the figure below, has to be designed in special moment resisting frame. The proposed building is located in seismic zone V and the soil conditions are soft. The lumped weight due to dead loads is  $8 \text{ KN/m}^2$  on floors and  $10 \text{ KN/m}^2$  on the roof. The floors are subjected to a live load of  $4 \text{ KN/m}^2$  and the roof to  $2 \text{ KN/m}^2$ . If the floors and roof at each level have area of  $320 \text{ m}^2$ , determine design seismic load on the structure as per I.S. : 1893 (Part 1) - 2002. For seismic zone V, the zone factor  $Z = 0.36$ , and the importance factor  $I = 1.5$ . The fundamental natural period of vibration ( $T_a$ ) in seconds may be estimated by the expression:  $T_a = 0.075 h^{0.75}$ , where  $h$  is the height of the building in m. Use the response spectra as shown in the figure below. [20]



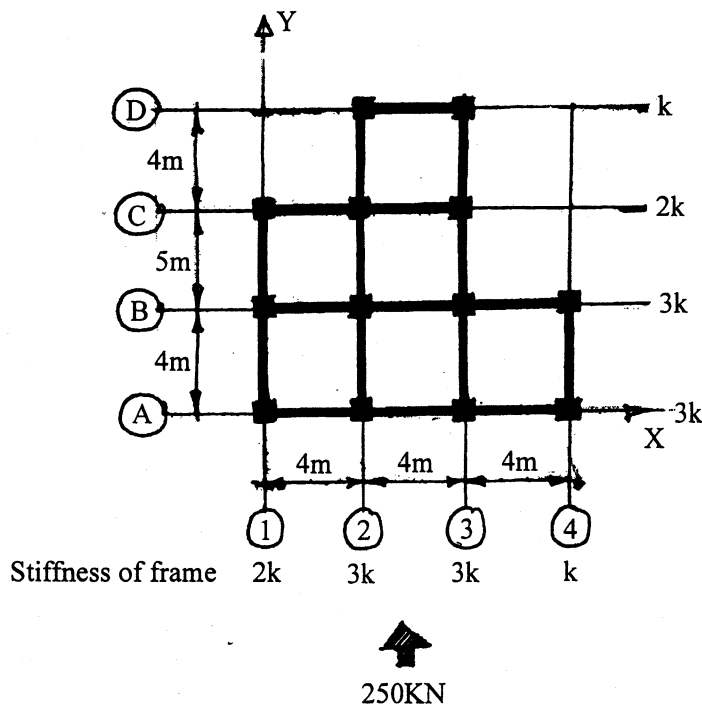
Idealized building



Response Spectra for Rock and Soil Sites for 5 percent Damping

4. a) The figure shown below presents the plan of a one-storey building, which may be considered as composed of 2-D frames along the orthogonal directions. The roof diaphragm is rigid in its own plane, and the mass of the roof is uniformly distributed. The building is subjected to an earthquake load of 250kN in y-direction and passing through the center of mass of the building. Calculate the lateral forces in the 2-D frames. (The lateral stiffness of 2-D frames are shown in the figure.)

[15]



- b) Describe the salient features of analysis of a multi-storied building with moment resisting frames in terms of global coordinates, if the stiffness matrix of plane frames in local coordinates are given.

[5]

5. Write short notes on (any four only)

[4×5]

- Seismic hazard analysis
- Response of a SDOF structure subjected to a ground motion with  $\ddot{v}_g(t) = \ddot{v}_{go} \sin \bar{\omega} t$
- Modal analysis of structures
- In-plane and out-of-plane behaviour of masonry structures
- Portal method of frame analysis
- Lateral stiffness of a solid shear wall

\*\*\*

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Rock Slope Engineering (Elective II) (CE76507)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Necessary figures are attached herewith.
- ✓ Assume suitable data if necessary.

1. Explain the aims of slope stability analysis. [4]
2. Enumerate the methods for rock slope stability analysis. Explain deterministic method of slope stability analysis with suitable example and figure. [1+7]
3. What the effect of ground water in slope stability? Describe protective measures with example. [4]
4. a) Define shear strength for planar and rough rock surfaces. [4]  
b) Explain the empirical method to determine the shear of rough rock surface proposed by Barton (1971). Also explain the advantages and its limitation. [4+2]
5. Describe the steps of seismic hazard analysis. [4]
6. List out the advantages and disadvantages of equal area net with respect to equal angle net. Describe the procedures for evaluation of potential slope problems. [6+6]
7. a) Explain the technique to measure the surface roughness suggested by Fecker and Rengers with suitable figure. Also explain the photographic mapping of exposed structures. [4+4]  
b) List out the geological information from discontinuity required for proper presentation. [4]
8. a) A 14 m high rock slope has been excavated at a face angle of  $58^\circ$ . The rock in which this cut has been made contains persistent bedding planes that dip at an angle of  $38^\circ$  into the excavation. The 4.35-m deep tension crack is 4 m behind the crest, and is filled with water to a height of 3 m above the sliding surface. The strength parameters of the sliding surface are as follows: [6+2]

Cohesion,  $c = 12 \text{ kPa}$

Friction angle,  $\phi = 35^\circ$

Unit weight of the rock,  $\gamma_r = 26.5 \text{ kN/m}^3$

Unit weight of water,  $\gamma_w = 9.81 \text{ kN/m}^3$

(i) Determine Factor of safety

(ii) Determine the tension required in rock bolt, installed normal to the sliding plane, to have a factor of safety of 1.5.

(b) Determine the factor of safety for following wedge geometry. [12]

Plane	Dip $^\circ$	Dip Direction $^\circ$	Properties
A	48	104	$\phi_A = 30^\circ$ , $c_A = 12 \text{ kPa}$
B	66	236	$\phi_B = 35^\circ$ , $c_B = 46 \text{ kPa}$
Slope face	62	188	
Upper surface	15	194	

Unit weight of rock =  $26 \text{ kN/m}^3$

Unit weight of water =  $9.81 \text{ kN/m}^3$

Height of wedge,  $H = 25 \text{ m}$ .

9. What are the different stabilization measures? Explain in brief about the shotcrete. [2+4]

\*\*\*

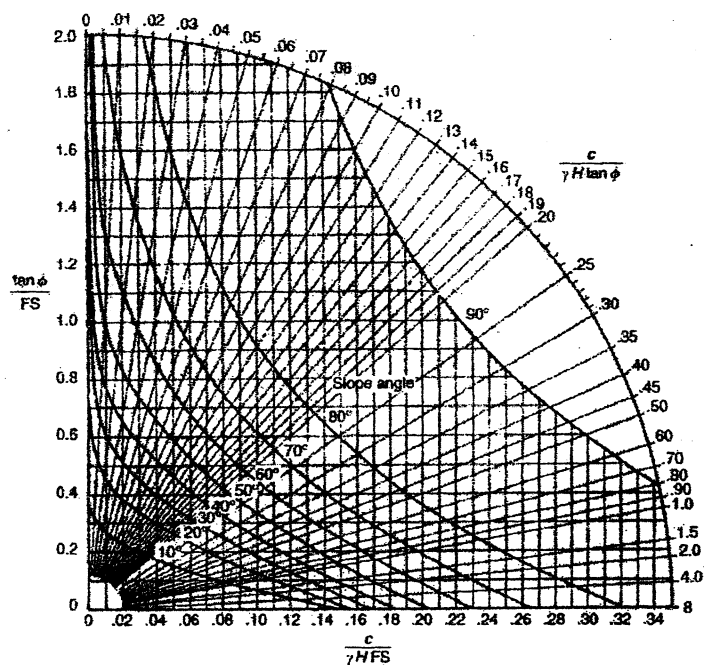


Chart:2

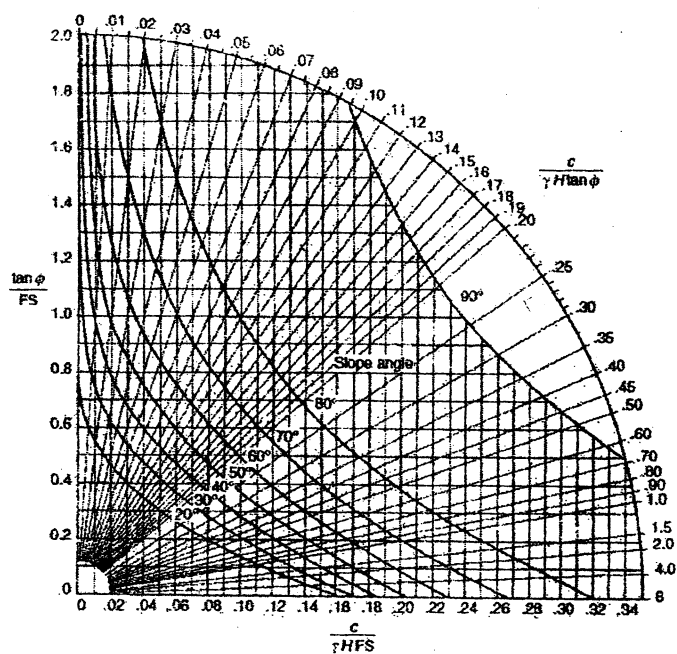


Chart:3

02C TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division.**  
2069 Bhadra

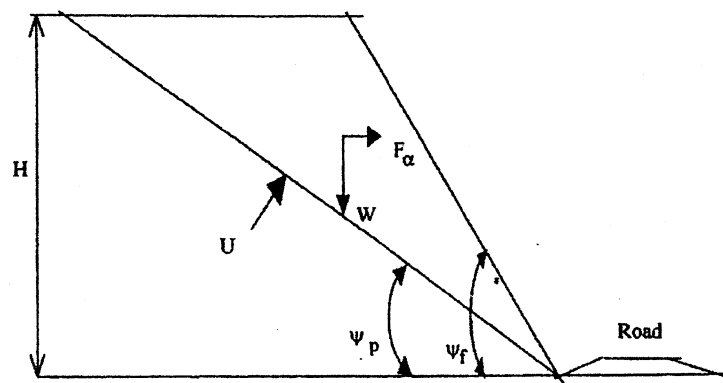
Exam.	Regular / Back •		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

***Subject: - Rock Slope Engineering (EG785CE) (Elective II)***

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any ***Five*** questions ***Question No. 1 is compulsory.***
- ✓ ***All*** questions carry equal marks.
- ✓ ***Necessary figures, equal area net and tracing paper are attached herewith.***
- ✓ Assume suitable data if necessary.

1. Calculate the Factor of Safety of a potential unstable slope with following input data:  
 Joint Set 1: 68/132 degrees (dip/dip direction)  
 Joint Set 2: 76/271 degrees (dip/dip direction)  
 Slope angle = 85/225 degree (dip/dip direction)  
 Upper Slope angle = 12/222 degree (dip/dip direction)  
 Slope height = 45 m  
 Unit weight of rock mass = 26 kN/m<sup>3</sup>  
 Unit weight of water = 10 kN/m<sup>3</sup>  
 Cohesive strength = 0.15 MPa  
 Basic friction angle = 28 degree
2. Write short notes on:
  - a. Shear strength of **Planar** and **Rough** surface of rock mass
  - b. Porosity and Permeability of rock and rock mass
  - c. Methods for rock slope stability analysis
  - d. The effect of water pressure in a tension crack and Reinforcement to prevent sliding
3. Explain Toppling Failure in rock mass. Discuss the conditions for sliding and toppling of a block on an inclined plane. Briefly discuss the types of Toppling failure and methods to control the rock falls.
4. Define the Circular Failure in rock mass. State the various assumptions which are made in deriving the circular failure charts. Discuss the steps to use the charts to determine the Factor of Safety of a potential unstable slope.

5. Explain basic aspects of Earthquake. Briefly discuss methods for quantification of Seismic load for rock slope stability analysis and basic methods for improving the stability of rock slope.
6. The geometry of the potential failure slope is given in Figure below. Find the Factor of Safety if basic friction angle is 28 degrees and cohesive strength is 0.1 MPa. Assume that slope having a tension crack in its upper surface, and depth of water is equivalent to depth of crack.



Schematic sketch of potential slope stability problem (plane failure)

In Figure;

$H$	=	Slope height = 50 m
$\psi_f$	=	Slope angle = 54 degree
$\psi_p$	=	Inclination of potential failure plane = 32 degree
$W$	=	Weight of potentially sliding rock (kN/m)
$\gamma_r$	=	Unit weight of rock mass = 24 kN/m <sup>3</sup>
$\gamma_w$	=	Unit weight of water = 10 kN/m <sup>3</sup>
$U$	=	Water pressure resultant (kN/m)
$F_\alpha$	=	m. $\alpha$ = Earthquake load (kN/m)

\*\*\*

**TRIBHUVAN UNIVERSITY**  
**INSTITUTE OF ENGINEERING**  
**KANTIPUR ENGINEERING COLLEGE**  
**Dhaphakhel, Lalitpur**  
**2072 Bhadra**

Exam	Final Assessment		
Level	B.E.	Full Marks	80
Programme	Civil	Pass Marks	32
Year / Part	IV/II	Time	3hr.

**Subject: Elective II (Rural Road Engineering)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt ALL questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1.     a) Explain the green road approach in the context of Nepal? Also discuss the technical issues regarding rural road planning in Nepal? [4]  
        b) Define DTMP? Write down the goal and objectives of DTMP? Write down the steps of planning process in rural roads based on DoLIDAR approach? [8]
2.     Design the total length of the valley curve at the junction of the descending gradient of 1 in 20 and an ascending gradient of 1 in 20, if the design speed is 40kmph in rural district road to fulfill head light sight distance for night driving. Calculate the lowest point and the end of curve point too, if the elevation of the beginning of the curve is 1000m above sea level. Assume other necessary data reasonably based on NRRS-2055/NRRS-2069. [10]
3.     Enlist the design parameters of hairpin bend? Also write down the design parameters of cross sections of rural road including traffic volume? Briefly outline the rural road classification, traffic and loading in rural road? [10]
4.     Why decentralized institutional arrangement is arrange in rural road? Outline the different partners, their roles and responsibilities on such decentralized institutions? State the function of technical support, management support and social mobilization support in the rural road implementation? [10]
5.     What do you mean by natural compaction? What are the tools and equipment used in rural road construction? State the use of flexible retaining and cross drainage structures? What should be considered for selecting a technically optimum alignment; Enlist main features? [10]
6.     Define bio-engineering? How can bio-engineering conserved the environment? What are the measures are taken for water management of rural roads? [10]
7.     What are the general economic consideration in rural roads? What is the cost of green road? Define the term construction cost, maintenance cost, rehabilitation cost in rural roads? Define public auditing? How can you conducted the public auditing in rural roads? [10]
8.     What are the minimization of maintenance requirements? Define the term and state the function of rehabilitation and upgrading in rural roads? [8]

05C TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2071 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Rock Slope Engineering (Elective II) (CE76507)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

- ✓ 1/ What are the Rock Slope Stabilization and protection works? Explain the deterministic method of Rock Slope Stability analysis. [4+8]
- ✓ 2/ List the effects of groundwater on slope stability. How the shear strength of rough surface be quantified? Explain it. [4+6]
3. Write down the process of determination of shear strength of rock mass. How can the earthquake magnitude be determined? [4+4]
- ✓ 4/ What are the graphical techniques for data problems? Explain, how can the potential slope problems be evaluated? [4+6]
- ✓ 5/ What is geological investigation? Write down the process of mapping of exposed structures. [4+6]
- ✓ 6/ A 12 m high rock slope has been excavated at a face angle of  $60^\circ$ . The rock in which this cut has been made contains persistent bedding plane that dip at an angle  $30^\circ$  into the excavation. The 4.25 m deep tension crack is 4 m behind the crest and filled with water upto 3 m. [10]

Given,

Cohesion  $C = 25 \text{ kPa}$

Friction angle,  $\phi = 30^\circ$

Seismic acceleration,  $\alpha = 0.08 \text{ g}$

The unit weight of rock is  $26 \text{ kN/m}^3$  and the unit weight of water is  $9.81 \text{ kN/m}^3$ .

Calculate the factor of safety of the slope for the conditions given for critical depth of tension crack.

- ✓ 7/ Consider a 6.5 m high slope with an overhanging face at an angle of  $75^\circ$ . There is a fault dipping at an angle of  $15^\circ$  out of the face at the toe of the slope that is weathering and undercutting the face. A tension crack wider at the top than at bottom has developed 1.8 m behind the crest of the slope indicating that the face is marginally stable. The friction angle of fault is  $20^\circ$  and the cohesion  $C$  is 25 kPa. The slope is dry. [12]
  - a) Calculate factor of safety of the block against sliding if density of rock is  $24 \text{ kN/m}^3$ .
  - b) What stabilization measure would be appropriate for this slope?

- ✓ 8/ What is shotcreting? Write down the methods of support and lining in rock slope. [3+5]

\*\*\*

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Rock Slope Engineering (Elective)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions. **Question No. 1 is compulsory.**
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ **Equal area stereonet and tracing paper are provided.**
- ✓ Assume suitable data if necessary.

1. Define the mode of failure and calculate the factor of safety (FS) for following input data: [20]

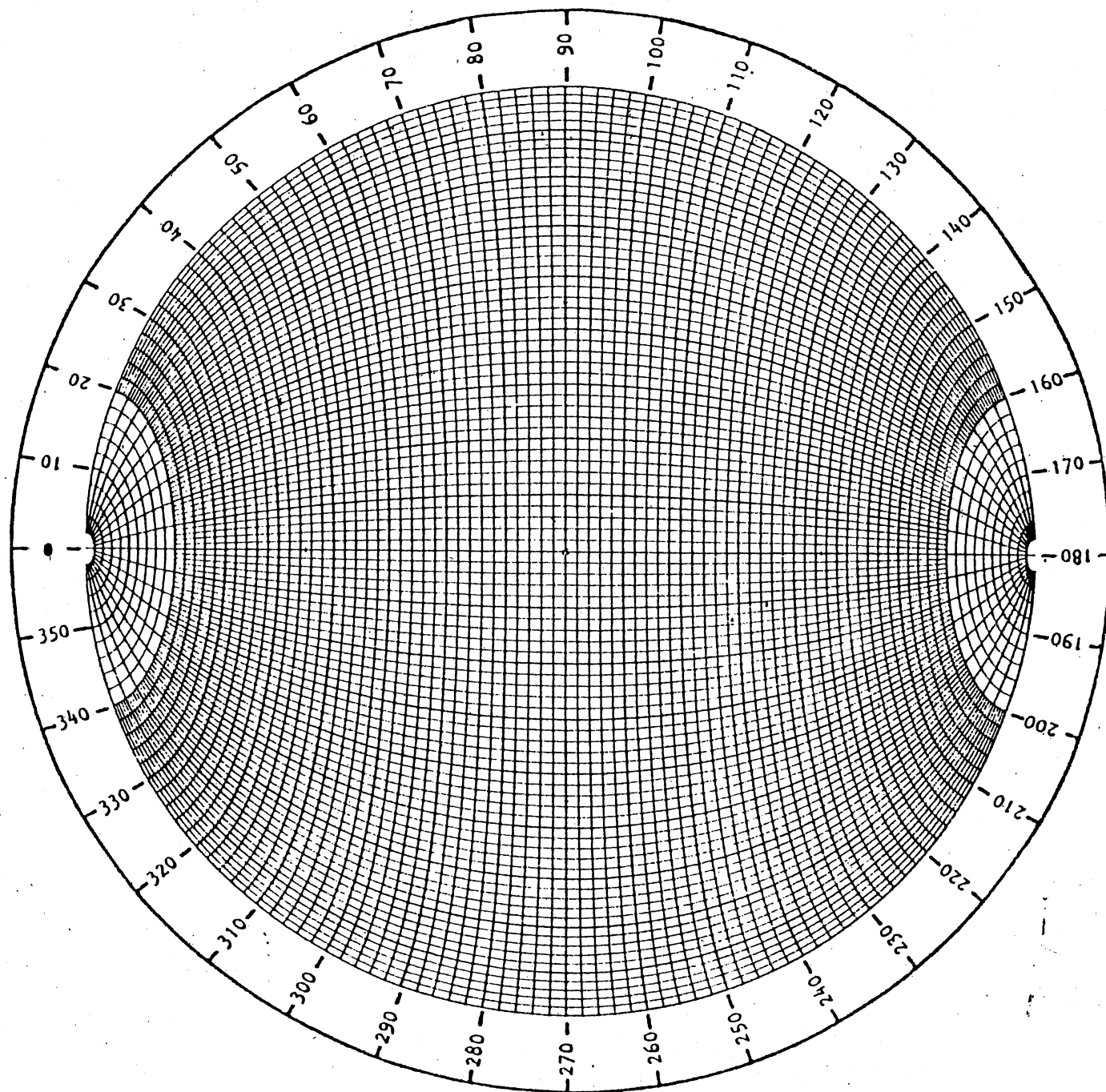
Plane	Dip (Degree)	Dip Direction (Degree)
A	45	105
B	70	235
Slope Face	65	185
Upper Surface	12	195

**Properties:**

$\phi_A = 30^\circ$ ,  $\phi_B = 20^\circ$  (Basic friction angle of plane A & B)  
 $C_A = 500 \text{ lb/ft}^2$ ,  $C_B = 1000 \text{ lb/ft}^2$  (Cohesive strength of plane A & B)  
Unit weight rock mass ( $\gamma_r$ ) =  $160 \text{ lb/ft}^3$   
Unit weight of water ( $\gamma_w$ ) =  $62.5 \text{ lb/ft}^3$   
Total height = 130 feet

2. Discuss the deterministic method in rock slope stability analysis. [15]
3. State and discuss 'porosity' and 'permeability' of rock and rock mass. Briefly discuss the possible effects of pressure of groundwater in rock mass. [15]
4. a) Give analysis for sliding due to gravitational loading on an inclined plane surface. [9]  
b) Define effective "Stress Law". [6]
5. Explain the term "shear strength of planar surface and shear strength of rough surface". [15]
6. Write short notes on: [3×5]  
a) Groundwater pressure models  
b) Slope de-pressurisation  
c) Conditions and types of toppling failure

\*\*\*



Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs

**Subject: - Rock Slope Engineering (Elective)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
  - ✓ Attempt any **Five** questions. **Question No. 6 is compulsory.**
  - ✓ **All** questions carry equal marks.
  - ✓ **Necessary equal area stereonet and tracing paper A4 size are attached herewith.**
  - ✓ Assume suitable data if necessary.
- Discuss the ground water effects on slope stability. Explain (i) models of water pressure distribution along potential sliding plane and (ii) slope drainage and de-pressurization measures to increase the stability of rock slopes.
  - Explain toppling failure. Discuss the various conditions and types of toppling failure. What are the recommendations for control the rockfalls?
  - Write notes on:
    - Planning of slope stability programme
    - Field estimate of Joint Roughness Coefficient (JRC) and Joint Compressive Strength (JCS)
    - Determination of earthquake magnitude in rock slope stability analysis
    - Probabilistic method in rock slope stability analysis
  - Calculate the factor of safety of a potential unstable slope with following input data:  
 Slope height (H) = 60m  
 Slope angle ( $\psi_f$ ) = 50 degrees  
 Inclination of potential failure plane ( $\psi_p$ ) = 30 degrees  
 Unit weight of rock mass ( $\gamma_r$ ) = 26 KN/m<sup>3</sup>  
 Unit weight of water ( $\gamma_w$ ) = 10 KN/m<sup>3</sup>  
 Active friction angle ( $\phi_a$ ) = 48 degrees  
 Seismic acceleration = 0.309
  - Define circular failure in rock mass. State the various assumptions are made in deriving the circular failure charts. Discuss the steps to use the charts to determine the factor of safety of a potential unstable slope.
  - Calculate the factor of safety of a potential unstable slope with following input data:
    - Slope height (H) = 60m
    - Basic friction angle ( $\phi_b$ ) = 30 degrees
    - Cohesive strength (C) = 0.15 MPa
    - Rock density ( $\gamma_r$ ) = 26 KN/m<sup>3</sup>
    - Water density ( $\gamma_w$ ) = 10 KN/m<sup>3</sup>
    - Joint mapping data and geometry:

	Dip (degrees)	Dip direction (degrees)
Plane A	46	106
Plane B	68	236
Slope Face	68	184
Upper Slope Face	14	196

\*\*\*

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Hill Irrigation Engineering (EG785CE) (Elective II)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Ten** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

- Describe about the types of drainage crossings used in HIS. Which of them is most suitable in remote hills and explain why? [8]
- Describe briefly the mountain zone classification with neat sketch. Why the classification is need? [8]
- Enumerate important guidelines to be considered for the success of hill irrigation systems. [8]
- Calculate 80% reliable april flow for an ungauged catchment A using the data of hydrologically similar catchment B. A has main april flow equal to  $4.1 \text{ m}^3/\text{s}$  from 3 years of measurement. B has mean april flow for the same 3 year period equal to  $4.8 \text{ m}^3/\text{s}$ . The long term mean april flow and standard deviation for B is equal to  $4.4 \text{ m}^3/\text{s}$  and 1.25 respectively. [8]

**OR**

Determine half monthly values from 80% reliable monthly rainfall data (mm) for 12 months. [8]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5	15	18	36	68	151	320	225	140	30	12	9

- What is participatory approach? Describe the advantages and disadvantages of participatory approach with reference to hill irrigation system in Nepal. [2+6]
- Define the rate of sprinkler application for a crop having root depth 70 cm and consumptive use 6 mm/ day, if the sprinklers can be operated 12 hour in a day. Assume that available water in the soil is 25%. [8]
- Determine the scour bed slope of a settling basin for a HIS having medium intake site. Design discharge = 450 lps. The average settling velocity of the sediment particles to be trapped in the basin is 0.02 m/sec. Critical bottom velocity in the settling basin to prevent rescouring of settled particles can be taken as 0.25 m/s. Assume scour velocity for sediment flushing equal to 1.85 m/s. [8]
- Determine the dimensions of a steel rack for a bottom rack intake of HIS. Flow rate upstream of the rack = 420 lps; flow rate downstream of the rack = 170 lps; rack opening = 15mm; bar diameter = 30mm; plugging coefficient = 0.02. Assume coefficient of discharge = 0.5. [8]
- Estimate concentration of sediment by mass during monsoon in the absence of local data for a catchment of 381 sq. km. Assume density of sediment equal to  $2 \text{ t/m}^3$  and the river transports 50% of the annual sediment load in 3 months of the monsoon. Assuming a mean monsoon discharge of the river be  $3.5 \text{ m}^3/\text{sec}$ . [8]
- Describe with neat sketches, the layout patterns of distribution system appropriate to hill irrigation canals. [8]
- Design a cascade drop to lower the water level in a canal by 3m. The canal discharge of 500 lps, U/S and D/S canal bed width 0.85m and water depth is 0.65m, the existing ground slope at the drop is 1:2 (H:V) [8]
- Describe about the use and advantages of gabion construction in remote hill areas with sketches. [8]

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Hill Irrigation Engineering (EG785CE) (Elective II)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Ten** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. Describe about the types of drainage crossings used in HIS. Which of them is most suitable in remote hills and explain why? [8]
2. Describe briefly the mountain zone classification with neat sketch. Why the classification is need? [8]
3. Enumerate important guidelines to be considered for the success of hill irrigation systems. [8]
4. Calculate 80% reliable april flow for an ungauged catchment A using the data of hydrologically similar catchment B. A has main april flow equal to  $4.1 \text{ m}^3/\text{s}$  from 3 years of measurement. B has mean april flow for the same 3 year period equal to  $4.8 \text{ m}^3/\text{s}$ . The long term mean april flow and standard deviation for B is equal to  $4.4 \text{ m}^3/\text{s}$  and 1.25 respectively. [8]

**OR**

Determine half monthly values from 80% reliable monthly rainfall data (mm) for 12 months. [8]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
5	15	18	36	68	151	320	225	140	30	12	9

5. What is participatory approach? Describe the advantages and disadvantages of participatory approach with reference to hill irrigation system in Nepal. [2+6]
6. Define the rate of sprinkler application for a crop having root depth 70 cm and consumptive use 6 mm/ day, if the sprinklers can be operated 12 hour in a day. Assume that available water in the soil is 25%. [8]
7. Determine the scour bed slope of a settling basin for a HIS having medium intake site. Design discharge = 450 lps. The average settling velocity of the sediment particles to be trapped in the basin is 0.02 m/sec. Critical bottom velocity in the settling basin to prevent rescouring of settled particles can be taken as 0.25 m/s. Assume scour velocity for sediment flushing equal to 1.85 m/s. [8]
8. Determine the dimensions of a steel rack for a bottom rack intake of HIS. Flow rate upstream of the rack = 420 lps; flow rate downstream of the rack = 170 lps; rack opening = 15mm; bar diameter = 30mm; plugging coefficient = 0.02. Assume coefficient of discharge = 0.5. [8]
9. Estimate concentration of sediment by mass during monsoon in the absence of local data for a catchment of 381 sq. km. Assume density of sediment equal to  $2 \text{ t/m}^3$  and the river transports 50% of the annual sediment load in 3 months of the monsoon. Assuming a mean monsoon discharge of the river be  $3.5 \text{ m}^3 / \text{sec}$ . [8]
10. Describe with neat sketches, the layout patterns of distribution system appropriate to hill irrigation canals. [8]
11. Design a cascade drop to lower the water level in a canal by 3m. The canal discharge of 500 lps, U/S and D/S canal bed width 0.85m and water depth is 0.65m, the existing ground slope at the drop is 1:2 (H:V) [8]
12. Describe about the use and advantages of gabion construction in remote hill areas with sketches. [8]

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Hill Irrigation Engineering (Elective)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. a) Compute dripping hours for a 16mm dripline with 3 lit/hr dripper, if lateral spacing of the dripline is 1m and dripper spacing is 0.7m. The crop has 60cm rooting depth and extractable water from the soil is 0.15 fractions. Also check the pressure variation in the dripline of 70m length, if drippers are operated at a pressure of 2 atmosphere. Assume pressure loss equal to 6m per 100m of dripline and  $c = 0.356$  for required number of drippers. [10]
  - b) Determine the storage volume of a gravel trap having a discharge of 550 lps and maximum sediment concentration of  $1.6 \text{ kg/m}^3$ . Assume that the gravel will be trapped at a rate of  $1.3 \text{ kg/m}^3$  having bulk density of  $2 \text{ t/m}^3$ . [6]
  2. a) Design a cascade drop to lower the water level in the canal by 4m. The canal is carrying a discharge of 400 lps, having bed width 65cm. The existing ground slope at the drop is 3:1 (H:V). [8]
  - b) What is the design criteria of diversion flow for irrigation projects in Nepal? How this flow can be assessed in the context of Nepal? [8]
  3. a) Which alternative methods of irrigation to canal irrigation are appropriate and cost effective in the hills of Nepal? Why they are sustainable? [8]
  - b) Determine half monthly values from monthly  $ET_0$  data (mm/day) for 12 months. [8]
- |     |     |     |     |     |     |     |     |     |     |     |     |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| 1   | 2   | 3   | 4   | 5   | 6   | 7   | 8   | 9   | 10  | 11  | 12  |
| 1.5 | 2.6 | 3.9 | 3.8 | 4.8 | 5.3 | 4.3 | 3.6 | 3.1 | 2.5 | 2.4 | 1.8 |
4. a) Design a settling basin for a HIS having good intake site. Design discharge = 500 lps; size of silt to be trapped = 0.4mm. Take  $Q/A_s = 0.015$  and critical bottom velocity = 0.25 m/s. Assume scour velocity for flushing = 1.8 m/s. [10]
  - b) How engineering and vegetative measures are used in the canal construction of a HIS? Describe with neat sketches. [6]
  5. a) List out the main problems that the FMIS are facing in the hills of Nepal. Also mention their respective solution. [8]
  - b) What are the areas of drop structures vulnerable to cavity erosion? How drop structures can be used to control erosion and water level of canal in HIS? [8]
  6. Write short notes on any four of the following: [4×4]
    - a) Institutional development of WVA's
    - b) Advantages and disadvantages of participatory approach
    - c) Use of level crossings in HIS
    - d) Characteristics of fill material in gabion structures
    - e) Flow division structure used in HIS

12C TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2064 Poush

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Hill Irrigation Engineering (Elective)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) What are the design-principles of a settling basin? List out the physical features needed to fulfill the design requirements of a settling basin. [8]
- b) Determine half monthly values from 80% reliable monthly rainfall data (mm) for 12 months. [8]

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
11	17	20	32	64	156	324	260	140	50	15	12

2. a) Give stepwise procedures for designing the distribution layout for a new hill irrigation system. [8]
- b) Define the rate of a sprinkler application for a crop having root depth 1m and  $ET_{crop}$  equal to 4.5 mm/day. The sprinklers are decided to be operated half day. Assume that the extractable water from the given soil condition is 0.25 fraction. [8]
3. a) What can go wrong with aqueducts and what are the preventive measures for that? [8]
- b) Design a cascade drop to lower the water level in the canal by 2.5 m. The canal is carrying a discharge of 250 lps, having bed width 50cm. The existing ground slope at the drop is 2:1. [8]
4. a) Estimate concentration of sediment by mass during monsoon in the absence of local data for a catchment of 381 sq. km. Assume density of sediment equal to  $2t/m^3$  and the river transports 50% of the annual sediment load in 3 months of the monsoon. [8]
- b) Design a steel rack for a bottom rack intake of HIS. Flow rate upstream of the rack = 400 lps; flow rate downstream of the rack = 200 lps; rack opening = 15 mm; bar diameter = 30 mm; plugging coefficient = 0.02. Take  $C_d = 0.5$ . [8]
5. a) Flow measurement made on 21<sup>st</sup> April on a river stream was 400 lps, drained from a catchment of 40 sq. km. Estimate the mean monthly flow and 80% reliable flow from this catchment, if predicted 80% April flow is 40% of April mean monthly flow. MIP non-dimensional regional hydrographs for mean monthly and 80% reliable flow of the region are given below: [8]

Flow, $m^3/s$ /Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean monthly	2.42	1.82	1.36	1.00	0.91	2.73	11.21	13.94	10.00	6.52	4.55	3.33
80% reliable	2.38	1.77	1.35	1.00	1.08	2.23	6.15	13.85	10.77	6.54	4.42	3.27

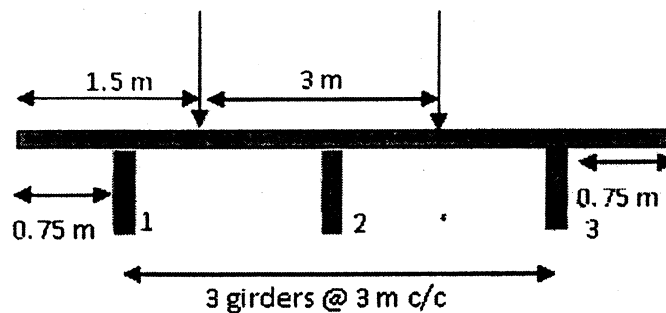
- b) "Sprinkler and Drip irrigation are sustainable methods in the hills of Nepal". Justify this statement. [8]
6. Write short notes on any four of the following: [4\*4]
  - a) Institutional Development of WUAs
  - b) Need of escapes in HIS
  - c) Distribution boxes and Sancho-
  - d) Vegetative measures in filling area
  - e) Seepage problems in hilly canals and their solutions

Exam.	Regular / Back •		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

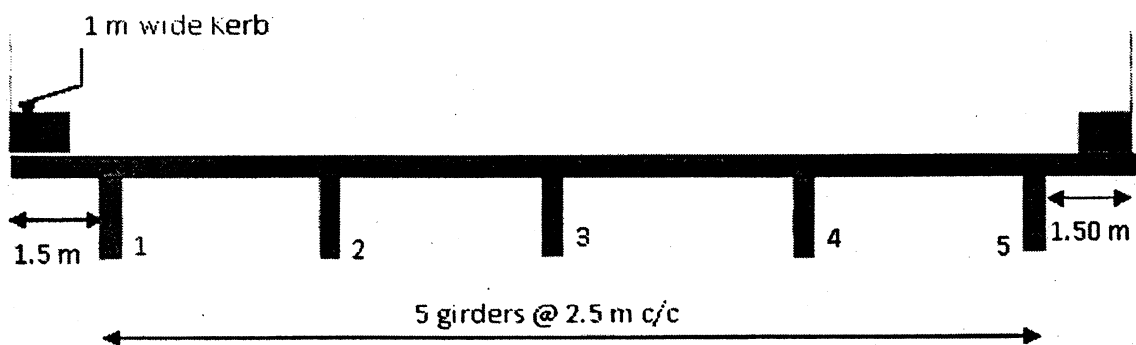
**Subject: - Design of Bridges (EG785CE) (Elective II)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ All questions carry equal marks.
- ✓ All IRC codes including IS 800, IRC 06, 21, 22, 24, 78 and 83 are allowed to use.
- ✓ Assume suitable data if necessary.

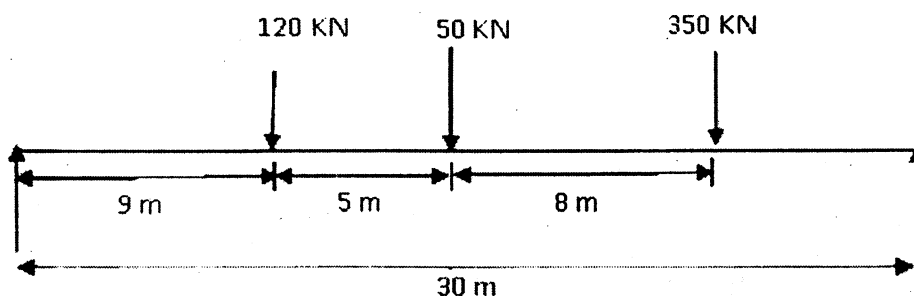
1. For the following loading find equivalent loads at standard positions to be used for Morrice-Little method.



2. For the following RCC Bridge deck slab, design the cantilever slab given that the dead load of all elements including deck-slab in the cantilever portion gives SF of 20 kN (per m width) and Bending moment at the edge of Girder 1 of 15 kN-m. Assume suitable girder width and select appropriate loading class.



3. A truck and Trailer combination having an axle loads as shown in figure rolls across simply supported span of 30 m. Compute the position of Maximum BM.



4. Design an Exterior Longitudinal Girder of RCC Slab-Girder bridge if the design moment is 1500 kN-m and design shear force is 600 kN. Assume other suitable information.
5. Calculate the stresses on foundation of the pier shown below from the following data (You may neglect effect of water current).

Bridge span: 20 m

Loading on Span: IRC Class AA

Design dead load from superstructure: 7000 kN

Longitudinal force at bearing level = 150 kN

Top width : 1.5 m

Height of pier upto bearing level: 10 m

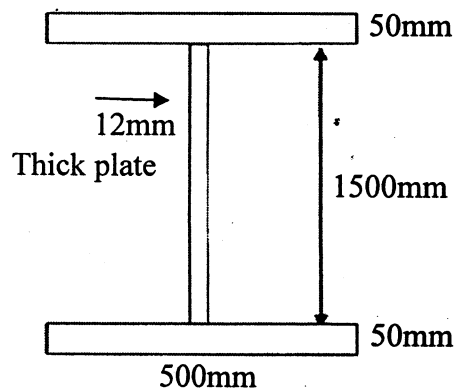
c/c of bearing on either side: 1.0m

Side slope of pier is 1 in 10

HFL - 1 m below bearing level

Concrete: M25

6. In a Steel Plate Girder bridge designed from BM 5500 kN-m and SF 1200 kN, Check whether the following section is safe for bending stress and Shear Stress or not.



7. Write short notes on any two
- Bearings in Bridges
  - Maintenance of Bridges
  - Classification of Bridges

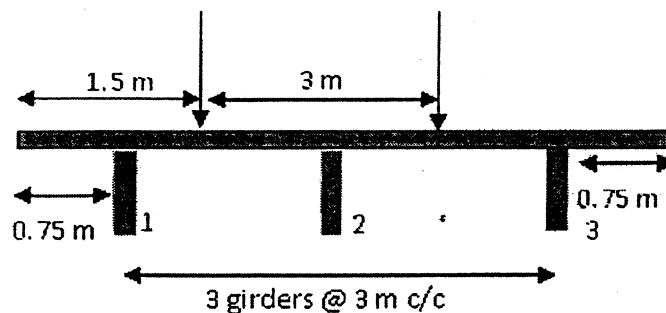
\*\*\*

Exam.	Regular / Back •		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

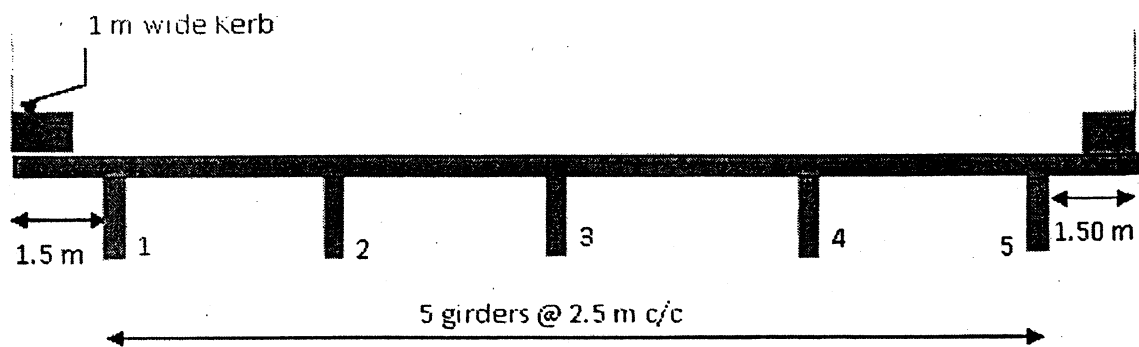
**Subject:** - Design of Bridges (EG785CE) (Elective II)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any Five questions.
- ✓ All questions carry equal marks.
- ✓ All IRC codes including IS 800, IRC 06, 21, 22, 24, 78 and 83 are allowed to use.
- ✓ Assume suitable data if necessary.

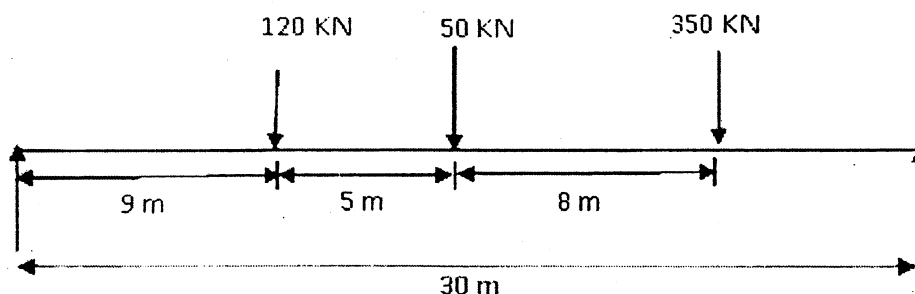
1. For the following loading find equivalent loads at standard positions to be used for Morrice-Little method.



2. For the following RCC Bridge deck slab, design the cantilever slab given that the dead load of all elements including deck-slab in the cantilever portion gives SF of 20 kN (per m width) and Bending moment at the edge of Girder 1 of 15 kN-m. Assume suitable girder width and select appropriate loading class.



3. A truck and Trailer combination having an axle loads as shown in figure rolls across simply supported span of 30 m. Compute the position of Maximum BM.



4. Design an Exterior Longitudinal Girder of RCC Slab-Girder bridge if the design moment is 1500 kN-m and design shear force is 600 kN. Assume other suitable information.
5. Calculate the stresses on foundation of the pier shown below from the following data (You may neglect effect of water current).

Bridge span: 20 m

Loading on Span: IRC Class AA

Design dead load from superstructure: 7000 kN

Longitudinal force at bearing level = 150 kN

Top width : 1.5 m

Height of pier upto bearing level: 10 m

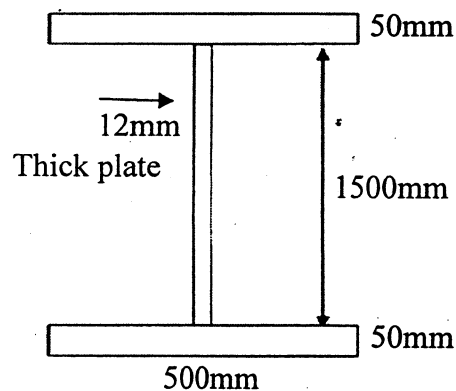
c/c of bearing on either side: 1.0m

Side slope of pier is 1 in 10

HFL - 1 m below bearing level

Concrete: M25

6. In a Steel Plate Girder bridge designed from BM 5500 kN-m and SF 1200 kN, Check whether the following section is safe for bending stress and Shear Stress or not.



7. Write short notes on any two
- Bearings in Bridges
  - Maintenance of Bridges
  - Classification of Bridges

\*\*\*

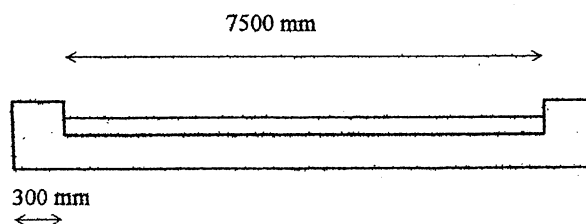
Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / I	Time	3 hrs.

**Subject: - Bridge Engineering (Elective I)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Four** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ IRC: 6-1966, IRC: 21-1987, IRC: 5-1985 are allowed to use.
- ✓ Assume suitable data if necessary.

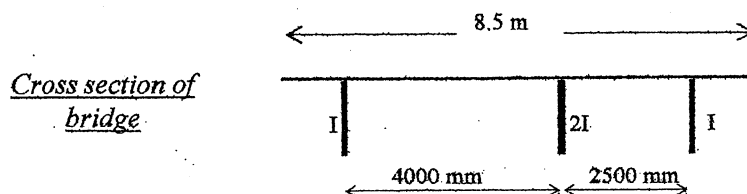
1.

- a. Write the limitations of the Courbon's method of lateral load distribution in bridge deck. [5]
- b. Find maximum bending moment at the mid span and shear force at the end of the slab bridge of effective span 7m due to class AA tracked load. Slab is 200mm thick and wearing course is 60mm thick. [15]



2.

- a. Find reactions on the girders, when the center of class AA tracked load coincides with the center of bridge deck. Use Courbon's Method to find the reactions. [15]

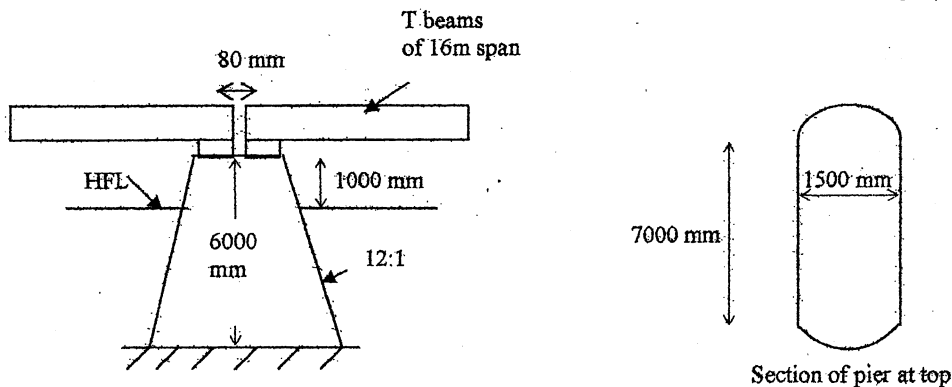


- b. Write the characteristics of frame and arch bridges. [5]

3.

- a. Find the stresses due to dead load of pier, braking force of 70 R tracked load, buoyancy and forces due to water current at the base of solid pier. Pier is made up of cement concrete. Take velocity of water current = 2.6 m/sec, dead load from each span = 400 kN and reaction due to live load on one span = 500 kN.

[15]



- b. Draw a neat sketch of abutment showing all its components? Briefly describe their functions.

[5]

4. a. Arrange wheel loads from Class B load in the longitudinal direction of the girder to find the maximum bending moment at the mid span and determine maximum bending moment due to this load. Take effective span of girder 28 m.

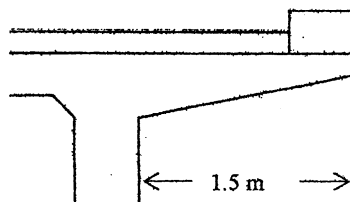
[15]

- b. Describe how impact load is considered in the design of bridge by IRC method.

[5]

5. a. Design a RC cantilever slab of T-Beam Bridge subjected to class A load. Width of kerb is 0.3m and thickness of wearing course is 70 mm.

[15]



- b. How the restrained slab is analyzed by Pigeaud's Method?

[5]

05M TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2070 Bhadra

Exam.	Regular		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject:** - Traffic Engineering and Management (*Elective II*) (CE76513)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ All questions carry equal marks.
- ✓ Necessary figures and tables are attached herewith.
- ✓ Assume suitable data if necessary.

1. In a traffic study experiment, density values obtained are 160, 120, 40, and 72 veh/km corresponding to speed values of 3, 18, 55, 32 kmph respectively. Calibrate Greenshields' model using above values. Also find the maximum flow and speed corresponding to 35 kmph.
2. Discuss the methods of traffic measurement over a short section of highway.
3. An observer wishes to determine the time headway between successive vehicles on a section of highway and counts 400 veh/h. Determine the number of headways greater than or equal to 6 seconds, and less than 12 seconds. Assume that headways are exponentially distributed.
4. A six lane urban freeway is on rolling terrain with 10 ft lanes, obstructions 3 ft from the right edge of the traveled pavement and 1.25 interchanges per mile. The traffic stream consists of primarily commuters. A directional weekday peak hour volume of 2200 vehicles is observed, with 700 vehicles arriving in most congested 15 min count. If the stream has 10% large trucks and buses and no recreational vehicles, determine the free flow speed and LOS.
5. The width of approaches for a rotary intersection is 15 m. The entry and exit width at the rotary is 10 m. Table below gives the traffic from the four approaches, traversing the intersection. Find the capacity of the rotary.

Approach	LT	TH	RT
North	415	643	350
South	549	358	424
East	402	450	408
West	450	423	493

6. An intersection approach at an isolated pre-timed signal with a cycle length of 80 sec has a saturation flow rate of 3,000 veh/h. The length of the green is 24 sec. The v/c ratio is 0.95. Determine the LoS, if control delay is measured over a 15 min interval?
7. What are the characteristics of multilane highway? Explain the different parameters of congestion measurement.
8. What is ramp metering? Discuss traffic flow ranking on TWSC intersection.

Table 4

Interchanges Per Mi.	Reduction in Free-Flow Speed, $f_{ID}$ (mi/h)
$\leq 0.50$	0.0
0.75	1.3
1.00	2.5
1.25	3.7
1.50	5.0
1.75	8.3
2.00	7.5

Table 5

Factor	Type of Terrain		
	Level	Rolling	Mountainous
$E_T$	1.5	2.5	4.5
$E_R$	1.2	2.0	4.0

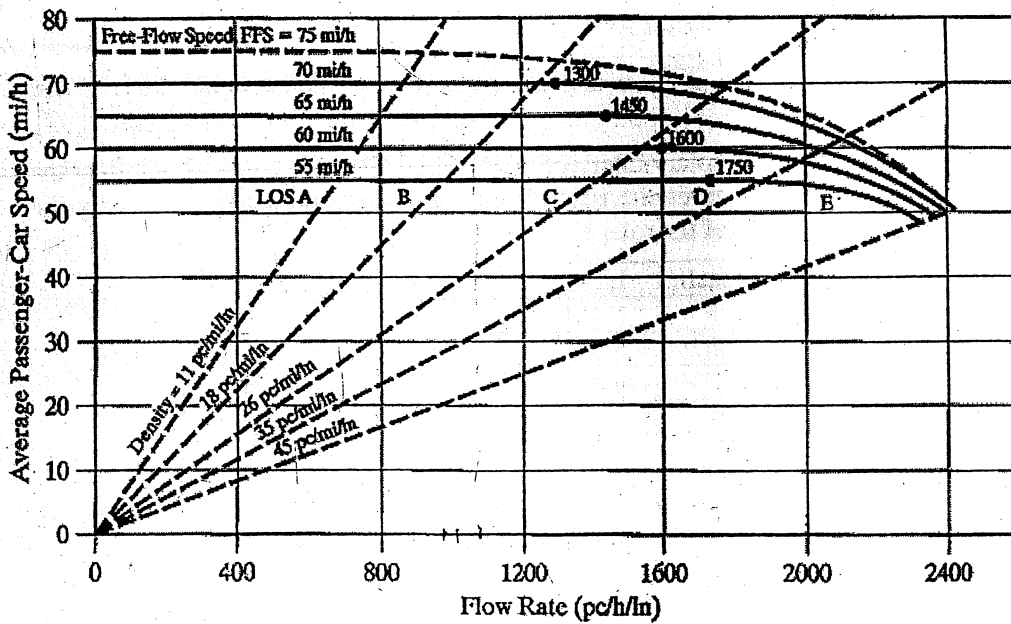


Table 0

Level of Service	Control Delay (s/veh)
A	$\leq 10$
B	$> 10 - 20$
C	$> 20 - 35$
D	$> 35 - 55$
E	$> 55 - 80$
F	$> 80$

Table 1

Lane Width (ft)	Reduction in Free-Flow Speed, $f_{LW}$ (mi/h)
$\geq 12$	0.0
11	1.9
10	6.6

Table 2

Right Shoulder Lateral Clearance (ft)	Reduction in Free-Flow Speed, $f_{LC}$ (mi/h)			
	Lanes in One Direction			
	2	3	4	$\geq 5$
$\geq 6$	0.0	0.0	0.0	0.0
5	0.6	0.4	0.2	0.1
4	1.2	0.8	0.4	0.2
3	1.8	1.2	0.6	0.3
2	2.4	1.6	0.8	0.4
1	2.0	2.0	1.0	0.5
0	3.6	2.4	1.2	0.6

Table 3

Number of Lanes (in one direction)	Reduction in Free-Flow Speed, $f_N$ (mi/h)
$\geq 5$	0.0
4	1.5
3	3.0
2	4.5

9. Table below shows the traffic flow for a four legged intersection. The lost time per phase is 2.0 seconds, saturation headway is 2 seconds, amber time is 3 seconds per phase. Assume critical volume to capacity ratio as 0.90. Find the cycle length, and green time. Draw the phase diagrams.

Form	To	Flow (veh/h)
North	South	750
South	North	450
West	East	650
East	West	500

10. Vehicles arrive at an entrance to a toll booth. There is a single gate at which all the vehicles must stop, where a booth attendant collects the toll fee. Vehicles arrive at an average rate of 250 veh/h. if the time required to collect the toll is 10 seconds, compute the average length of the queue, average waiting time in the queue, average time spent in the system and percent of server idle time. Assume both arrival and departure of vehicles to follow Markovian process.

\*\*\*

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Design of Frames and Shells (Elective II)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Four** questions. **Question No. 4 is compulsory.**
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ IS 456; IS 3370; IS 785; IS 1161; IS 875; IS 806; and IRC 21 is allowed for design reference values and design data necessary for calculations.
- ✓ Assume suitable data if necessary.

1. Define Ferro-cement as per ACI Committee 549. List all possible applications of Ferro-cement. Write down the differences and similarities between Ferro-cement and Reinforced Concrete. [20]

2. An elevated water tank has a raft foundation circular in plan with diameter of 11 m measured at center line of the circular RC girder over it. It has 8 symmetrically placed columns resting over the girder. The UDL on the girder from foundation raft as reaction is 375 KN/m. The materials used are M25 and Fe415. Design the girder with appropriate geometry for critical section for maximum shear and torsion. Show reinforcement details of the section. [20]

n (columns)	K <sub>1</sub> (-ve B.M.)	K <sub>2</sub> (+ve B.M.)	K <sub>3</sub> (Torsion)	θ (for Torsion)
8	0.0083	0.0041	0.0006	9°30'

3. Design an RC pole 8 m long to carry 4 conductors of 6.5 mm diameter each spaced at 400 mm intervals in a cross arm fixed at 450 mm from the top. The depth of embedment is 1.5 m below ground level. Spacing of poles is 45 m; wind pressure is 1.2 KN/m<sup>2</sup>; horizontal seismic coefficient is 0.12; load factor is 2.5; tension in conductor is 2.75 KN; concrete M25 and reinforcement Fe500. Prepare all possible load combinations. For design load combinations you may use either one of the critical horizontal loadings. Show reinforcement details for the design. [20]

4. How can box culvert be modeled for finite element based structural stress analysis? List all the possible load patterns for the analysis of single chamber box culvert in a cut-and-covered section. You are required to demonstrate (numerically or conceptually) the entire load cases with corresponding loading diagrams. [20]

5. Sketch the design bridge loading for AASTHO HS-20-44 Loading (standard truck loading). Calculate the maximum moment on the slab bridge having an effective span of 5.0m; spanning in one direction for a concentrated load of 72 KN and it is distributed over the perpendicular direction of the span to a distance of 3m. Calculate the maximum bending moment due to the live load and dead load. The wearing surface of the slab is 75mm and the thickness is assumed to be of 400mm. [20]

6. a. An RC circular tank has its top covering as a portion of spherical dome. The tank cylindrical has diameter 10 m. Concrete is M20 and reinforcement is Fe415. Design the dome conforming to standard codes. [10]

- b. Design a rectangular water tank walls. The tank rest on ground. The inside dimension is 8 m x 6 m in plan and 6 m high including 0.5 m freeboard. Concrete is M20 and reinforcement Fe415. [10]

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BEL, BEX	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Micro-Hydro Power (Elective)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any **Five** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.

1. Describe the major components of a micro- hydro scheme. Explain in detail about their functions and criteria needed to consider during design. [16]
2. (a) What are the four stages recommended approach to design a micro hydro scheme? [8]
 

(b) A 20 kW plants supply power to 100 HHs ( 200 W /HHs) for 6 hours for lighting at night and 12 kW for Agro mills for 8 hours in day time. If the Capital Cost of the scheme is NRs. 3,600,000.00 and annual O+M cost is 5% of total capital cost then find following ( considering 15 years economic life of the plant and 12% discount factor):

  - i. Plant Factor
  - ii. Unit Energy Cost
  - iii. Net Present Value ( if Revenue is 360,000.00/ annum) [8]
3. (a) Explain various methods of the head measurement . Discuss the method in detail which better represent the bend on the way. [8]
 

(b) What do you mean by part flow efficiency of a turbine? Explain with charts which turbines have better part flow efficiency? [8]
4. (a) Explain, why there is a need of AVR in addition to ELC in synchronous generator? [8]
 

(b) Describe voltage regulation, how it can be improved in Induction generator? [8]

Or

(c) Explain protection system needed in Micro hydro scheme. [8]
5. Differentiate between (any four) [4\*4]
  - (a) Plant Factor and Load Factor
  - (b) Desilting and Forebay
  - (c) Anchor block and Slide block
  - (d) Impulse and reaction turbine
  - (e) Synchronous and Induction generator
  - (f) ELC and IGC
6. (a) What are the major issues in Micro- hydro sector in Nepal. Describe the government subsidy policy for micro and pico hydro. [8]
 

(b) Let us suppose a 60 kW hydro set power a tea factory requiring 3-phase, 50 Hz and the factory is 350 m distance from generator site. The worst power factor measured was 0.5 . According to manufacturer alternator is 420 V phase to phase and tea owner wants voltage drop up to 380 V. Assuming an overhead line of aluminium conductor ( 7/4.9, 7 strand with each strand being 4.9 mm diameter and resistance of 0.217  $\Omega$ / km. Calculate whether the voltage drop is within the limit or not? [8]

[ Note:  $L=A* (5+46 \log_{10} (d/r)) * 10^{-38}$  H/ phase, make necessary assumptions if needed ]

06C TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2071 Bhadra

Exam.	Regular / Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject: - Procurement Management (Elective III) (CE78503)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) ✓ What do you mean by procurement? Explain procurement cycle. [2+5]  
b) ✓ What are the importances of procurement planning? Write contents of Master Procurement Plan and prepare a format. [3+4]
2. a) ✓ Why Open Competitive Bidding method of procurement is mostly used in public procurement? Differentiate National Competitive Bidding (NCB) and International Competitive Bidding (ICB) method of procurement. [2+3]  
b) ✓ What is cost reimbursable contract? Explain. [4]  
c) ✓ What are the objectives of community participation? Discuss force account. [2+3]
3. a) ✓ Define Contract and classify them. [1+2]  
b) ✓ Explain about the Unit Price Contract and Lump Sum Contract with their advantages and disadvantages. [5]  
c) ✓ Discuss BOOT Contract and its use in Nepal. [4]
4. a) ✓ Mention the basic procedures for the selection of consultant by public entity. [4]

**OR**

- Write down the Eligibility criteria and Ranking criteria for the short listing of consultants. [4]
- b) ✓ ToR is the document prepared by the client which is to be provided to the consultants to be participated in the procurement process. What are the matters to be included in the ToR? [4]
  - c) ✓ Specification is also a part of bid document. What are the purposes of specification? Write the general principles of specification writing. [3+3]
  5. a) ✓ What Qualification Criteria would you consider while preparing bid document for a construction project having cost estimate NRs. 60 millions in the Post - qualification system? Write down the purpose of pre-bid meeting. [2+2]

**OR**

How do you evaluate the bids which are submitted for a construction project having cost estimate NRs. 60 millions in the post qualification system. [4]

b) Discuss activities during closing of contract.

[4]

*OR*

What are the factors to be considered for time extension in a contract?

[4]

✓ Define Alternate Dispute Resolution (ADR). What are the benefits of ADR? Explain about Arbitration.

[1+2+3]

6. a) Write importance of standard contract document. Write the general features of FIDIC Red Book.

[3+3]

*OR*

Discuss different methods of hiring of consultant as per ADB Guidelines.

[6]

✓ b) What are the objectives of Technical Audit? Write the methodology of Technical Audit generally practiced in the context of our country.

[2+4]

\*\*\*

02A TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
2065 Baishakh

Exam.	Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs

**Subject: - GIS (Elective)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any ***Five*** questions.
- ✓ ***All*** questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. What are the four main functions of GIS? Explain briefly.
2. a) What is the difference between DEM and DTM? Explain the weighted average method for interpolation of DEM.  
b) Explain potential applications of DEM in civil engineering.
3. a) Explain the principle of differential GPS.  
b) What are the advantages and disadvantages of using GPS survey compared to conventional methods?
4. a) Explain the advantages and disadvantages of raster data model compared to the vector data model.  
b) Explain the relation database model used in GIS.
5. a) Why is geometric correction needed in remote sensing? Explain the use of GCP for this purpose.  
b) What is false color composite? Explain why forest appears red in most FCCs.
6. Explain how you would carry out a study on urbanization of Kathmandu valley in the past twenty years using GIS and remote sensing.

12D TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**  
**2064 Poush**

Exam.	Regular/Back		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

---

***Subject: - GIS (Elective)***

---

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt any ***Five*** questions.
- ✓ ***All*** questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. a) Briefly explain the main data sources in a GIS.  
b) What is the difference between GIS, Remote Sensing and GPS?
2. a) Explain the three main components of a GIS system  
b) What is the difference between a DEM and DTM? Explain the concept of weighted average method in interpolation.
3. a) Explain how you can make a map of your campus area using a simple hand held GARMIN GPS and also discuss the accuracy of such mapping.  
b) How does the differential GPS improve the accuracy?
4. a) Why do we need map projection in GIS?  
b) Explain the difference between cylindrical, conical and azimuthal map projections.
5. a) Explain the difference between spatial, spectral and temporal resolution in remote sensing.  
b) What is a false color composite? Explain how it could be useful in remote sensing.
6. Explain how you would make a map of urban expansion of Kathmandu valley in the last five years using GIS and remote sensing.

Exam.	Regular / Back •		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject:** - Geographic Information System (EG785CE) (Elective II)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain briefly major areas of GIS application. 5
2. Compare between raster and vector model. Compress the following raster using quad tree method. 5+5

A	A	A	A	E	E	E	E
A	A	A	A	E	E	E	E
F	F	B	B	E	E	E	E
F	F	B	B	E	E	E	E
D	D	D	D	C	C	D	D
D	D	D	D	C	C	D	D
D	D	D	D	E	E	F	F
D	D	D	D	E	E	F	F

**OR**

How do you apply GIS & Remote Sensing to identify a best suitable area for Landfill site in Kathmandu Valley? Mention the data sources and analysis for it. 10

3. Describe briefly any four : 10
  - a. Advantages of topology    b. Terrain features    c. Hierarchical database model
  - d. Merits and demerits of raster model    e. TIN
4. a. What are the ideal characteristics of a distortion free map? Explain a map projection that fits for Nepalese context. 2+8
  - b. What are the cases of geographic transformation from one to another? 5
  - c. Describe the importance of tangent and secant in map projection. 5
5. Mention the minimum hardware & software requirement for ArcGIS 9.3. 5
6. a. Describe the processes of conversion of an image to land cover/use. 10
  - b. Explain briefly GPS & DGPS. Describe sources of errors in GPS. 5+5
7. Describe briefly merge & buffer functions with applications. 5
8. What are the basic elements of map layout? Mention the role of symbolization in map layout. 5

Exam.	Regular / Back ●		
Level	BE	Full Marks	80
Programme	BCE	Pass Marks	32
Year / Part	IV / II	Time	3 hrs.

**Subject:** - Geographic Information System (EG785CE) (Elective II)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. Explain briefly major areas of GIS application. 5
2. Compare between raster and vector model. Compress the following raster using quad tree method. 5+5

A	A	A	A	E	E	E	E
A	A	A	A	E	E	E	E
F	F	B	B	E	E	E	E
F	F	B	B	E	E	E	E
D	D	D	D	C	C	D	D
D	D	D	D	C	C	D	D
D	D	D	D	E	E	F	F
D	D	D	D	E	E	F	F

**OR**

How do you apply GIS & Remote Sensing to identify a best suitable area for Landfill site in Kathmandu Valley? Mention the data sources and analysis for it. 10

3. Describe briefly any four : 10
  - a. Advantages of topology    b. Terrain features    c. Hierarchical database model
  - d. Merits and demerits of raster model    e. TIN
4. a. What are the ideal characteristics of a distortion free map? Explain a map projection that fits for Nepalese context. 2+8
  - b. What are the cases of geographic transformation from one to another? 5
  - c. Describe the importance of tangent and secant in map projection. 5
5. Mention the minimum hardware & software requirement for ArcGIS 9.3. 5
6. a. Describe the processes of conversion of an image to land cover/use. 10
  - b. Explain briefly GPS & DGPS. Describe sources of errors in GPS. 5+5
7. Describe briefly merge & buffer functions with applications. 5
8. What are the basic elements of map layout? Mention the role of symbolization in map layout. 5

\*\*\*