

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2083 Baishakh

Exam.	Back		
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.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Define bioengineering. Briefly discuss its functions and limitations.
2. Explain about major causes and mechanisms of slope failures in hilly regions of Nepal.
3. How is a landslide different from mass wasting? Mention the repair priorities of the landslide based on history.
4. Define plant propagation. Discuss different types of vegetative propagation methods.
5. Define a nursery. List out different components with neat sketches.

6. Estimate the effect of vegetation on the factor of safety on a given infinite slope.

Soil cohesion = 5 kPa

Unit weight of the soil = 18 kN/m³

Slope angle = 35 degree

Angle of internal friction of soil = 35 degree

The root characteristic per sqm is given below

SN	Root dia (mm)	No. of roots	Tensile strength (MPa)	Distortion angle (Degrees)
1	20	26	6	15
2	55	40	10	12
3	85	10	15	10

7. Define a plant community. Discuss the major factors to be considered when selecting plant species for bioengineering techniques.
8. Describe the following vegetative systems based on their functions, site requirement, limitations and species used.
 - a) Vertical line grass plantation
 - b) Brush layering
 - c) Check dam
 - d) Fascines
9. List out the different retaining structure generally used along with bioengineering techniques. Describe the construction procedure of gabion wall.
10. Write short notes on: (Any Two)
 - a) Gabion bolster
 - b) Site characterization for selection of optimal bioengineering technique.
 - c) Schedule for maintenance of bioengineering.

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Bhadra

Exam.	Regular		
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. Justify Bio-engineering as the sustainable technique for landslide mitigation. [8]
2. What are the major component of a landslide? How can the slope failures be categorized based on the effectiveness of Bio-engineering applications? [4+4]
3. Define Plant propagation. Explain various propagation methods for grass, shrubs and trees. [2+6]
4. Calculate amount of increase in shear strength by using perpendicular root reinforcement model (Wu Model) in a slope after 6 years of tree plantation from the following data. [8]

No. of roots	Root diameter(cm)	Tensile strength of root fiber (MPa)	Average angle of shear distortion
24	6	18	22
18	9	10	20
10	8	12	15
20	5	20	18

Take: Angle of internal friction = 30 degree and Area of root coverage = 4 m²

5. How does moisture availability affect the selection of plant species? Write down the selection procedure of plant based on the drought factor. [4+4]
6. Differentiate between horizontal and vertical line of grass plantation with neat sketches. [8]
7. Define small scale civil engineering system. Describe wire bolster cylinder. [4+4]
8. Discuss various factors affecting the selection of optimal techniques in Bio-engineering. [8]
9. What is nursery and what are its advantages? List out the different components of nursery with neat sketches. [3+5]
10. Write short notes on: (Any Two) [2×4]
 - a) Maintenance of bioengineering works
 - b) Hydrological functions of vegetation
 - c) Construction of brush layer

TRIBHUVAN UNIVERSITY
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Examination Control Division
2081 Baishakh

Exam.	Back		
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.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.



1. Define Bio-engineering. Discuss the main engineering functions with examples of civil and bioengineering structures. [2+6]
2. What are the major parts of a landslide? How can the slope failures be categorized based on the effectiveness of Bio-engineering applications? [4+4]
3. What do you mean by landslide mapping? Write down the steps of landslide mapping with sketches. [2+6]
4. What are the basic criteria for plant species selection in Bio-engineering? Explain the process of Final Choice of Plant Type. [8]
5. A site has been treated with tree plantation with the root characteristics given as below. Estimate the increase in the shear strength of the slope materials if the angle of internal friction of the slope material is 25° and the area of root coverage is 5.5 m^2 . [8]

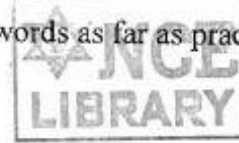
No. of roots	Diameter of roots(mm)	Tensile strength of root fiber, Mpa	Average angle of shear distortion in the shear zone
12	10	25	15
20	14	30	15
25	16	16	21
29	20	24	23

6. Define palisades with sketch. Explain the process of site preparation, material requirement, operation, function and limitations of palisades in slope stabilization. [2+6]
7. How relative strength of vegetative and civil structure varies over time? What are the steps involved in bolster construction? [4+4]
8. Define Nursery. List the main component of Nursery. What are the steps to be followed for Nursery site selection? [1+3+4]
9. Explain optimal techniques. [8]
10. Write short notes on: (Any Two) [2×4]
 - a) Retaining walls
 - b) Basic requirements of plants
 - c) Layering and its types

Exam.	Regular		
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.
- ✓ Attempt **All** questions.
- ✓ The figures in the margin indicate **Full Marks**.
- ✓ Assume suitable data if necessary.



- Define soil Bio-Engineering. Discuss about the advantages and limitations of Bio-engineering. [8]
- Explain about the major causes and mechanism of slope failure in hilly regions of our country. [8]
- Fill in the blank boxes given below: [8]

Civil structures	Functions	Applications	Advantages	Limitations
Riprap				
Gravity walls				
Check dams				
Causeways				

- After 7 years of tree plantation, it was found that following root system was developed in a slope. Calculate amount of increase in shear strength, if angle of internal friction of slope material is 32 degree and root were observed in C/S of 4.5 m² in a closed landfill with the help of the following diagram. [8]

No of roots	Dia. of roots (cm)	Tensile strength of root fiber (MPa)	Angle of shear distortion in shear zone, degree
14	2	10	18
13	5	21	12
20	7	11	29
22	3	18	26

- What are the basic criteria for plant species selection in Bio-engineering? Explain the process of Final Choice of Plant Type. [8]
- Define Nursery. List the main component of Nursery. Explain about the steps of Nursery Site selection. [8]
- Fill in the blank boxes given below: [8]

Vegetative technique of bioengineering	Major Functions	Site requirements/ applications	Time of maturity	Limitations
Horizontal line of grass plantation				
Vertical line of grass plantation				
Brush layering				
Turfing				

- What are the factors contributing to an increase in shear stress? Discuss mass movement and its types. [8]
- Discuss about the hydraulic, Hydrological and Mechanical role of vegetation. [8]
- Write short notes on: (Any Two) [2×4]
 - Maintenance activities in bio-engineering works
 - Basic requirements of Plants
 - Plant propagation
 - Guidelines for applying the Bio-engineering works

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2080 Baishakh

Exam.	Back		
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 bioengineering. Explain how the civil engineering structures interacts with the vegetative structures in respects to time and relative shear strength. Draw different graphs for different interacting structures. [8]
2. Write down the causes and Mechanisms of Landslide. Discuss about the slope stability based on the mineral types. [8]
3. How a best optimal technique if finalized as the best Bio-engineering practice in a particular site? [8]
4. a) What do you know about plant treatment? What would be the frequency of carrying out maintenance activities?
b) Write down the factors to be considered for the selection of a nursery site. What would be the criteria to fix the spacing of nursery sites? [4+4]
5. A site has been treated with tree plantation with the root characteristics given as below. Estimate the increase in the shear strength of the slope materials by perpendicular root area method-if the angle of internal friction of the slope material is 20° and the area of root coverage is 4 m^2 . [8]

Dia of roots, mm	No. of roots	Tensile strength of root fibre, Mpa	Average Angle of shear distortion in the shear zone
10	12	30	18
15	18	15	18
18	24	20	15
20	30	16	15

6. What are the factors governing the distribution of vegetation? Discuss the major vegetation zones of Nepal. [8]
7. Enlist different vegetative stabilization techniques which are commonly used in bio-engineering practice and write down the procedures for the construction of brush layering. [8]
8. List out all small civil engineering structures that are used in bioengineering techniques. Explain any three of them with its main engineering function. [8]
9. Explain about the mass movement and its classification indicating factor contributing to increase in shear stress. [8]
10. Write short notes on: (Any Two) [2×4]
 - a) Maintenance and care of young plants
 - b) Interaction between civil engineering structure and vegetative stabilization technique.
 - c) Grass plantation techniques
 - d) Asexual propagation of plant



TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Bhadra

Exam.	Regular	
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.

- How do you justify the use of Bio-Engineering techniques? What are the fundamental issues related to Bio-Engineering slopes? Define RAR and show its general trend. Estimated root reinforcement effect using the fiber-break model. [2+2+2+2]
- What are the main factors affecting slope stability? Discuss stability of slope based on mineral types. [8]
- Define small scale Civil engineering system. Discuss about Wire Bolster Cylinder. [8]
- What do mean by plant community and what are the factors that need to be considered while selecting the plant species for Bio-engineering techniques? [8]
- Estimate the effect of vegetation on the factor of safety on a slope using the infinite slope method. The basic expression of factor of safety in case of slope without vegetation cover is given below. Follow the notation and data accordingly to estimate the factor of safety in a slope. [8]

$$F = \frac{C + (YZ - Y_w h_w) \cos^2 \beta \tan \phi}{YZ \sin \beta \cos \beta}$$

Effective soil cohesion within the soil = 10 kN/m²

Unit weight of the soil = 18 kN/m³

Yielding soil depth = 1 m

Slope angle = 35 degree

Angle of internal friction of soil = 35 degree

Water table position above the yielding surface = 0.5 m

- Enlist different vegetative stabilization techniques which are used as bio-engineering practices in our country and explain about Brush Layering Technique. [8]
- Describe how hydrological components effect on instability of slope. List out the Mechanical functions of plants. [8]
- Performance-based evaluation method is applicable in Bio-engineered slopes. How do you do with the following instruments? (i) piezometer, (ii) inclinometer, (iii) extensometer, and (iv) Pressure cells and strain gauges. [4]
 - What would be the probable lab tests for the following root properties? (i) root-soil interaction, (ii) shear reinforcement, (iii) slope reinforcement, and (iv) root reinforcement. [4]
- What are the factors that have to be considered while establishing a Nursery? Draw the typical section of the Grass Bed in a nursery and mention its general requirements. [8]
- Write short notes on: (Any Two) [2×4]
 - Basic requirement of plants
 - Merits and demerits of Asexual plant Propagation
 - Guidelines for selecting of Optimal Bioengineering techniques
 - Bioengineering norms and specification

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Bhadra

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

Subject: - Bio-Engineering (Elective I)(CE 72504)

- ✓ 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.
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1. Describe scope and Fields of application of bio-engineering with suitable examples you visited in field.
 2. How slope stability is analyzed with different aspect? Explain anyone in brief with related examples.
 3. What do you mean by plant community? How plant community helps for the sustainability of bio-engineering practice?
 4. What are the roles of vegetation? Briefly explain the mechanical effect of vegetation with soil interaction.
 5. Enlist the major problems caused by land slide. Draw the typical landslide map showing all components.
 6. How can you select the plant species for bio-engineering in road side at mountainous region? Describe briefly.
 7. Briefly explain the relationship between vegetative and civil engineering system. Describe functional use of retaining wall in bio-engineering.
 8. What do you mean by optimal technique? Write down the procedure for the construction of brush layering and palisade.
 9. Define bio-engineering nursery. What are the factors that must be considered when establishing a nursery? Explain with suitable examples.
 10. Write short notes on: (Any Two)
 - a) Hydrological function of plant
 - b) Live checkdam
 - c) Disadvantages of bio-engineering



TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Ashwin

Exam.	Back		
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.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. What is Bio-Engineering? Describe different Bio-Engineering functions to address the problems on slope?
2. What are the causes of mass failure? Explain the different causes of mass failure in Nepal?
3. Discuss on relative strength of structures over time with figure.
4. Differentiate between horizontal and vertical vegetative Bio-Engineering techniques?
5. Explain the major purposes of cuttings that are used in Bio-Engineering techniques.
6. List out small civil engineering structures used in Bio-Engineering and describe checkdam, retention wall and gravity wall with their major functions in slope stabilization.
7. Explain the importance of Bio-Engineering programming during highway construction in hilly parts of our country. Describe the role of vegetation on slope stabilization.
8. What are the different types of mass movement? Explain them.
9. Write short notes on: a. Runoff related hazards b. Fascines
10. What is Nursery? What are the major components of nursery? Explain briefly.



06D / TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Ashwin

Exam.	Back		
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.
 - ✓ All questions carry equal marks.
 - ✓ Assume suitable data if necessary.
1. Define bio-engineering. Briefly explain about the different functions and applications of bio-engineering.
 2. Explain about the mass movement and its classification indicating factor contributing to increase in shear stress.
 3. Define nursery. What are the main components of nursery? Explain about the factors to be considered to select the nursery site.
 4. Explain about the causes and mechanisms of slope failure during highway construction in Nepal.
 5. What are the different factors that govern the distribution of vegetation in Nepal?
 6. List out all the small civil engineering structures that are used in bio-engineering techniques. Explain about the different walls with their engineering functions.
 7. Write short notes on:
 - i) Relative strength of structures over time
 - ii) Plant ecology of Nepal
 - iii) Palisades and mulching
 - iv) Maintenance activities in bio-engineering works
 8. Check dams are simple physical constructions to prevent the down cutting of runoff water in gullies. Explain about the practical features of check dams.
 9. Differentiate between horizontal and vertical line of grass plantation with figure.
 10. After 6 years of tree plantation, it was found that following root system was developed. Calculate amount of increase in shear strength, if angle of internal friction of slope material is 25 degree and root were observed in C/S of 2 m².

No. of roots	Dia. of roots (cm)	Tensile strength of root fiber (MPa)	Angle of shear distortion in shear zone
10	8	12	15
20	5	20	18
18	9	10	20
24	6	18	22



TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 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) (CE72504)

- ✓ 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 Bio-Engineering? What are the advantages and limitations of Bio-engineering?
2. Write down the causes and Mechanisms of Landslide. Enlist the steps for preliminary and detail landslide mapping in site.
3. What are the major component parts of a landslide? How can the slope failures be categorized based on the effectiveness of bioengineering applications?
4. Define Nursery. What are the factors that have to be considered while establishing a nursery?
5. A site has been treated with tree plantation with the root characteristics given as below. Estimate the increase in the shear strength of the slope materials by perpendicular root area method-if the angle of internal friction of the slope material is 25° and the area of root coverage is 2m^2 .

Dia or roots, mm	No. of roots	Tensile strength of root fibre, Mpa	Average Angle of shear distortion in the shear zone
7	10	20	17
11	20	10	18
15	18	18	15
19	24	12	22

6. Define Small Scale Civil engineering system. How they are interacting with vegetative engineering system? Explain with examples.
7. What are the basic criteria for plant species selection in Bio-engineering? Explain the process of Final Choice of Plant Type.
8. Enlist different vegetative stabilization techniques which are commonly used in bio-engineering practice and write down the procedures for the construction of Fascines.
9. Describe how hydrological components effect on instability of slopes. List out the engineering functions of Plants.
10. Write short notes on: (Any two)
 - a) Maintenance activities in bio-engineering works
 - b) Basic Requirements of Plants
 - c) Plant propagation
 - d) Guidelines for applying the Bio-engineering works



6 D TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING

Examination Control Division

2074 Ashwin

Exam.	Back		
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.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.

1. Define bio-Engineering. Briefly explain about the different functions and applications of bio-Engineering.
2. Explain about the mass movement and its classification indicating factor contributing to increase in shear stress.
3. Define nursery. What are the main components of nursery? Explain about the factors to be considered to select the nursery site.
4. Explain about the causes and mechanisms of slope failure during highway construction in Nepal.
5. List out the basic sixteen steps of landslide mapping technique that are used in Nepal.
6. What are the different purposes of cuttings that are used in vegetative systems of bio-engineering?
7. What are the different factors that govern the distribution of vegetation in Nepal?
8. List out all the small civil engineering structures that are used in bio-engineering techniques. Explain about the different walls with their engineering functions.
9. Write short notes on: (Any two)
 - a) Relative strength of structures over time
 - b) Plant ecology of Nepal
 - c) Palisades and mulching

10. After 6 years of tree plantation, it was found that following root system was developed. Calculate amount of increase in shear strength, if angle of internal friction of slope material is 30 degree and root were observed in C/S of 4m².

No. of roots	Dia. of roots (cm)	Tensile strength of root fiber (MPa)	Angle of shear distortion in shear zone
10	8	12	15
20	5	20	18
18	9	10	20
24	6	18	22



06D TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 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) (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. Describe scope and fields of application of bio-engineering. [8]
2. How slope stability is analyzed with different aspect? Explain any one in brief. [8]
3. What do you mean by plant community? How plant community helps for the switching of bio-engineering practice? [8]
4. What is the cause of failure? Draw typical landslide map showing all components. [8]
5. Describe how soil strength and stability analysis is important for vegetation. [8]
6. What is drought factor? Describe plant species selection based on drought factor. [8]
7. List out small scale civil engineering structures use in bio-engineering. Describe functional use of retaining wall in bio-engineering. [8]
8. Explain any three vegetative stabilization techniques with major function and design criteria. [8]
9. Define bio-engineering nursery. What are the factors that must be considered when establishing a nursery? [8]
10. Write short notes on: (any two) [4×2]
 - i) Optimal technique
 - ii) Engineering function of plant
 - iii) Basic requirement of plant

Exam.	Regular		
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.
- ✓ All questions carry equal marks.
- ✓ Assume suitable data if necessary.



1. What do you mean by the term "bio-engineering"? Write down its field of application and scope.
2. Estimate the effect of vegetation on the factor of safety on a slope using the infinite slope method. The basic expression of factor of safety in case of slope without vegetation cover is given below. Follow the notation and data accordingly to estimate the effect of vegetation.

$$F = \frac{c' + (\gamma z - \gamma_w h_w) \cos^2 \beta \tan \phi'}{\gamma z \sin \beta \cos \beta}$$

Where,

c' = effective soil cohesion within the soil (10 kN/m²); γ = unit weight of the soil (18 kN/m³);
 z = yielding soil depth (1.0 m); β = slope angle (35 degrees); ϕ = angle of internal friction of soil (35 degrees) and h_w = water table position above the yielding surface (0.5 m).

Assume,

Effective soil cohesion due to Root matrix (5 kN/m²); wind loading force parallel to slope (0.1 kN/m); surcharge load due to weight of vegetation (2.5 kN/m); angle between roots and slip surface (45 degrees)

3. Write down the causes and mechanisms of Landslide. Enlist the steps for preliminary and detail landslide mapping in site.
4. Define small scale civil engineering system. How they are interacting with vegetative engineering system? Explain with example.
5. How do you estimate the severity of the landslides and what will be your order of priority on those severities.
6. What are the basic criteria for plant species selection in bio-engineering? Explain the process of final choice of plant type.
7. Enlist different vegetative stabilization techniques which are commonly used in bio-engineering practice and write down the procedure for the construction of brush layer.
8. Write short notes on:
 - a) Progressive failure phenomena
 - b) Crib wall and reinforced earth for retaining structures
 - c) Use of Geo-synthetics material for slope stabilization
 - d) Nursery management

06D TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING

Examination Control Division
2071 Shawan

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.



- Define Bio-Engineering. Illustrate the engineering function of plants.
- What is weathering? Differentiate the slope materials based on the weathering grade.
- How is a landside different from mass wasting? Mention the repair priorities of the landslide based on its history.
- What is plant community? Why is it maintained in Bio-Engineering?
- 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° and the area of root coverage is 4m^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

- How can you select appropriate plant species for bio-engineering works in a particular area?
- Where can the diagonal lines of grass plantation be implemented as a vegetative system? Write down its implementation procedure.
- Define Small Scale Civil Engineering Structure. Explain particular features of checkdam that should be incorporated in its construction.
- Explain the importance of bio-engineering programming. Write down the physical requirements of seed bed.
- 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.	Regular		
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. How does Bioengineering defer from Biotechnical Engineering? Write down its scope and the fields of application of Bioengineering. [8]
2. What are the general forms of failures that take place in slopes in Nepal? Write down the general Criteria that lead to plane failure of rock. [8]
3. What are the major component parts of a landslide? How can the slope failures be categorized based on the effectiveness of Bioengineering application? [8]
4. How can the plants be grouped on the basis of root architecture? Write down the process of mineralization and function of compost. [8]
5. A site has been treated with tree plantation with the 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 25° and the area of root coverage is 2 m^2 . [8]

Diameter of roots, mm	No. of roots	Tensile strength of root fiber, MPa	Average Angle of shear distortion in the shear zone, $^\circ$
7	55	57	12
11	42	45	18
15	33	34	23
19	18	23	27

6. What are the improvement plants and colonizers? Write down the role of morphological characteristics of a plant on the selection of proper species of the plant. [8]
7. Where can the brush layering be implemented as a vegetative system? Write down its implementation procedure in detail. [8]
8. What is a catch drain? What are the general causes of its failures? Write down the function and implementation procedure of French drain as a sub-surface drainage system. [8]
9. How can the maintenance activities be categorized in Bioengineering works? Write down the process of bioengineering programming work based on the budget reimbursement and time. [4+4]
10. What are the factors that have to be considered while establishing a nursery? Draw a typical section of the stool cutting bed in a nursery and mention its general requirements. [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 (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° . 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

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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 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.	Regular		
Level	BE	Full Marks	30
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° . 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, $^\circ$
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.