試 験 科 目 名 Subject	
科目名　交通工学	
（英文）　Transportation Engineering	

受験番号 Examinee's Number	M

広島大学大学院先進理工系科学研究科（博士課程前期）入学試験問題（2025 年 10 月入学,2026 年 4 月入学）
Entrance Examination for Master's Course (October 2025 Enrollment, April 2026 Enrollment),
Graduate School of Advanced Science and Engineering

＜注意事項＞
1)　日本語または英語のどちらで解答してもよい。

＜Notice＞
1)　You can answer either in Japanese or English.

Please choose two out of the following four questions.

Question 1:

Japan's cost–benefit analysis manual for transport project appraisal recognizes three monetizable benefit items—travel-time savings, vehicle operating-cost reductions, and traffic-accident cost reductions—while some countries also treat travel-time reliability as an important performance metric. Answer the following questions.

(1) Briefly explain what each of the three monetizable benefit items recognized in Japan's cost–benefit analysis manual for transport project appraisal represents and give one example for each.

(2) When travel-time reliability is evaluated, a scheduling (departure-time) model is frequently employed. State the conventional functional form that represents the generalized cost (GC) of a trip, capturing the disutility of early arrival and late arrival.

(3) Explain how and why the disutility (generalized cost) of late arrival differs from that of early arrival in most empirical applications of the scheduling model.

(4) Identify at least two specific situations in which scheduling terms must be considered explicitly in transport appraisal.

Question 2:

A major disaster can block key roads and railways in a city's transport network. Engineers and planners say they need to improve "the system's resilience" (Figure 1). Answer the following questions.
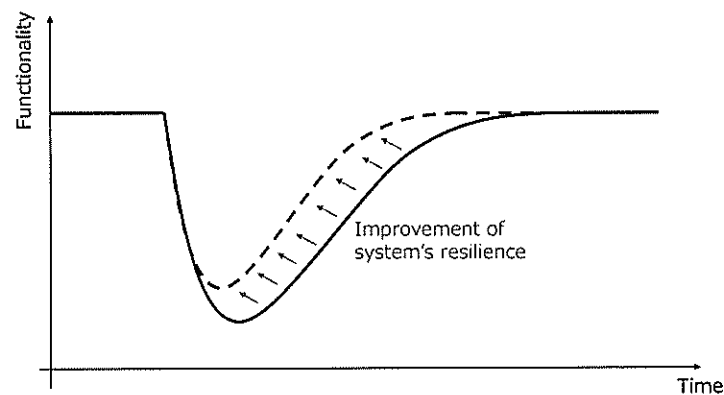

Figure 1. Improving the system's resilience

(1) In one or two sentences, define the transport-system resilience.

(2) After a disruptive event, a transport network's performance usually passes through the four phases listed below. For each phase, write one complete sentence that describes what is happening to the network's capacity or level of service during that phase.

     i) Pre-event phase

     ii) Disruption (Emergency) phase

     iii) Adaptation phase

     iv) Recovery phase

(3) Choose one real disaster (e.g., the 2011 Great East Japan Earthquake, the July 2018 Heavy Rain Disaster, and so on) and describe how the transport network's performance moved through the phases you defined above. In your answer, (i) name the event, (ii) briefly state the initial capacity loss, (iii) explain the speed and pattern of recovery, and (iv) comment on what that indicates about the network's resilience.

Question 3:

(1) Fundamental diagram (Figure 2): Explain what a fundamental diagram is when describing vehicular traffic flow. Also, list at least three major factors that determine the shape and key parameters (e.g., free-flow speed, capacity, and jam density) of a fundamental diagram. For each factor, give a brief explanation and one specific real-world example.
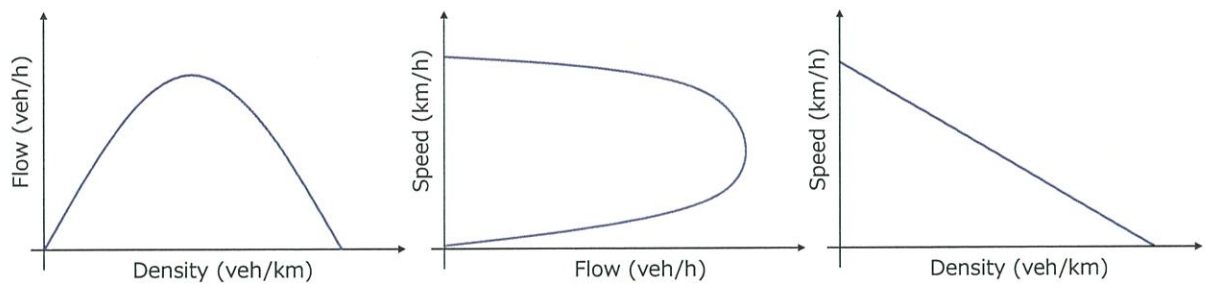

Figure 2. Fundamental Diagram

(2) Queueing at a bottleneck: Suppose that a two-lane motorway normally carries a capacity of 2400 veh/h. At 8:00 a crash blocks one lane, so capacity falls to 1200 veh/h for 30 minutes. Traffic demand entering the section stays at 1800 veh/h during the closure. Using the idea of arrival rate minus service rate (demand minus capacity), (i) state whether a queue will form, and (ii) estimate how many vehicles will join that queue by 8:30.

Question 4:

A traveler must choose one option from a finite set of transport alternatives—(i) car, (ii) bus and (iii) train. For each alternative j, the total utility is defined as $U_{ij} = V_{ij} + \epsilon_{ij}$, where V_{ij} is a deterministic component based on observable attributes, and ϵ_{ij} is an unobserved error term. Answer the following questions.

(1) Briefly explain the main differences between the multinomial logit (MNL) model and the multinomial probit (MNP) model, focusing on the distributional assumptions for ϵ_{ij}.

(2) Assume the error term ϵ_{ij} is independent and identically distributed with the Type-I extreme-value (Gumbel) distribution:

$$F_{ij}\left(\epsilon_{ij}\right) = \exp\left\{-\exp\left(-\frac{\epsilon_{ij}}{\theta_i}\right)\right\}, \qquad \theta_i > 0$$

Derive the probability P_{ij} that the traveler chooses alternative j.

(3) Explain why the resulting probability expression satisfies the property known as "independence of irrelevant alternatives (IIA)".

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問1.　次の問題に答えよ。

(1)　緯度勾配に沿った地球規模の種多様性のパターンについて、生物群系（バイオーム）との関係に着目して説明せよ。また、そのパターンが形成される理論仮説を 1 つ挙げ、その内容を説明せよ。

(2)　植物群集における機能的冗長性（functional redundancy）の定義を述べよ。さらに、機能的冗長性が、ある撹乱下の森林生態系を安定させる機構を説明せよ。

(3)　野生動物学における「恐怖の景観（landscapes of fear）」の定義を述べよ。さらに、それが野生動物の行動および適応度へ与える影響について、具体例を 1 つ挙げて説明せよ。

Question 1. Answer the following questions.

(1)　Explain the latitudinal patterns of global species diversity in relation to biomes. Then, explain one hypothesized mechanism that forms these patterns.

(2)　Describe the definition of functional redundancy in plant communities and explain the mechanisms by which functional redundancy can contribute to the stability of forest ecosystems under disturbance.

(3)　Describe the concept of 'landscapes of fear' in terms of wildlife biology and explain an example of how it influences the behavior and fitness of wild animals.

科目名　生態学

（英文）　Ecology

問2.　アメリカ合衆国のイエローストーン国立公園では、かつてハイイロオオカミ（*Canis lupus* Linnaeus, 1758）が絶滅したが、1995 年から 1996 年にかけて野生個体群の再導入が実施された。このオオカミの再導入について、生態学的な視点からあなたの意見を述べよ。3 段落構成のエッセイ形式（アカデミック・ライティング）に則り、その根拠を論理的に展開すること。

Question 2. In Yellowstone National Park in the United States, gray wolves (*Canis lupus* Linnaeus, 1758) were once extirpated. However, in 1995 and 1996, wild populations of wolves were reintroduced into the national park. State your opinion on this wolf reintroduction, based on ecological perspectives. Your statement must be structured as a three-paragraph academic essay, logically developing your reasoning.

問3.　あなたが生態を研究したいと思う野生生物を 1 つあげ、その生息地における生活環および生活史を説明せよ。また、その説明を踏まえ、研究目的と方法、および予想される結果を含む研究計画を作成せよ。

Question 3. Give the name of a wildlife species that you desire to study its ecology, and explain its life cycle and life history in its habitat. Based on that explanation, make a brief research plan that includes the research objective, methodology, and expected results.