TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2081 Chaitra

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

Subject: - Traffic and Transport Modeling *(Elective II) (CE 76510)*

- ✓ *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 model and model developing process in brief. Explain stated and revealed preference survey with examples. [4+4]
2. The probability that a vehicle will turn left at an intersection is 0.20. Assume independence, calculate probability of: [8]
   - Exactly 4 out of 10 will turn left
   - At least 4 out of 10 will turn left
3. How transport network is represented during transport modeling? Explain the various errors in modelling and forecasting process. [4+4]
4. Describe the importance of traffic forecasting in demand modeling. When the entry fee to a water park was Rs.20 per visit, the average number of visits per person was 80 per year. Since the rate has risen to Rs.25, the demand has fallen to 60 per year. What is the elasticity of demand over this range of prices? [4+4]
5. What are the base year inventories needed for transportation modelling? Explain in brief the roadside interview survey. [4+4]
6. Define trip, home-based and non-home-based trip. Discuss various factors affecting trip generation. [3+5]
7. A small study area has been divided into three zones and limited survey has resulted in the following trip matrix. [8]

Zone	1	2	3
1	25	25	25
2	12	13	20
3	30	25	35

Estimated future total trip generation for each zone are given below:

Zone	Future Trip Origin	Future Trip Destination
1	130	70
2	80	130
3	120	130

Use Furness Method to estimate future inter-zonal movements up to 2 iterations.

8. Differentiate between the Trip end and Trip Interchange modal split model. The total number of trips from zone i to zone j is 4200. Currently, all trips are made by car. The government has two alternatives- to introduce a metro or a bus. The travel characteristics and respective coefficients of all the alternatives are given in the table below. Decide the best alternative in terms of trips carried.
$C_{ij} = a_1 tijv + a_2 t_{ij}^{walk} + a_3 t_{ij}^{t} + a_4 F_{ij} + a_5 \phi_{ij}$ [2+6]

Parameter	Coefficient	Car	Bus	Metro
Travel time (t_{ij}^{v})	0.04	25	35	17
Walking time (t_{ij}^{walk})	0.03	-	8	14
Waiting time (t_{ij}^{t})	0.08	-	6	5
Fare (F_{ij})	0.3	22	8	6
Comfort (φ_{ij})	0.1	6	-	-

9. Two routes connect a city and a suburb. During the peak-hour morning commute, a total of 4500 vehicles travels from the suburb to the city. Route 1 has a 60kmph speed limit and is six kilometers in length, route 2 is three kilometers in length with a 45 kmph speed limit. Studies show that the total travel time on route 1 increases two minutes for every additional 500 vehicles added. Minutes of travel time on route 2 increase with the square of the number of vehicles, expressed in thousands of vehicles per hour. Determine user-equilibrium and system equilibrium travel times. [8]

10. Write short notes on: (Any Two) [2×4]
    a) Category Analysis
    b) Factors affecting mode choice
    c) Multipath assignment

***

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2079 Chaitra

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

Subject: *- Traffic and Transport Modelling (Elective II)(CE 76510)*

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt <u>All</u> questions.*
- ✓ *<u>All</u> questions carry equal marks.*
- ✓ ***<u>Necessary table is attached herewith.</u>***
- ✓ *Assume suitable data if necessary.*

1. Describe transport planning process. Explain the role of model in transportation planning process.
2. The posted speed limit of Ring Road (Koteshwor to Kalanki section) is 50 kmph. Concerned authority claims that more than 95% of vehicle exceed this speed limit and has decided to conduct the study. In a certain section it is found that average speed of vehicles as 53.34 kmph with standard deviation of 1.88 kmph. What proportion of vehicles exceed this speed limit? Comment on the claim.
3. What do you understand by TAZ? List out various zoning criteria. Explain various errors in modeling and forecasting process.
4. Discuss Elasticity model and its type with example. Why traffic forecasting is needed in transport modeling?
5. Explain, in brief, different transport surveys that are carried out.
6. A neighborhood has 205 retail employee and 770 HH that can be categorized with each type having characteristics as follows:

Type	HH Size	Annual Income ('000)	No. of worker
1	2	40	1
2	3	50	1
3	3	55	2
4	4	40	1

There are 100 type 1, 200 type 2, 350 type 3 and 50 type 4 HH. Assuming that shopping, social/recreational and work-based trips all occur at the same time, determine the total trips.

Shopping trips (Y) = 0.12 + 0.099* HH Size +0.011* Income ('000) -0.15* Employment in Neighbourhood ('00)

Social/recreational trips (Y) = 0.04+0.018*HH+0.009*Income+0.16*No. of workers.

7. There are five zones in a study area, where zones 1 and 2 are complete residential, zones 3, 4 and 5 are complete industrial area. The production and attraction are;

Zone I	P_I	A_J
1	1000	0
2	2000	0
3	0	600
4	0	900
5	0	1500

The travel time between zone 1-3 and 2-4 is 5 minutes, between 1-4 and 2-3 is 10 minutes, and between 1-5 and 2-5 is 15 minutes.
Distribute trips from 1, 2 to 3, 4 and 5 using gravity model (perform at most two iterations).
Take Friction factor = Travel-time$^{-1.925}$
Socio-economic adjustment factor as given in table below.

K_{IJ}	3	4	5
1	1.6	1	0.5
2	1	0.81	1.43

8. Briefly explain the factors that affect mode choice.
   There are 4000 work-based trips originating in zone A and ending in Zone B. The mode choice includes transit and automobile, and the utility function is estimated as:
   $U_{transit} = 0.8\text{-}0.05(cost_{transit})\text{-}0.03(travel\text{-}time_{transit})$
   $U_{automobile} = 2.2\text{-}0.05(cost_{automobile})\text{-}0.03(travel\text{-}time_{automobile})$
   Where cost is in rupees and time is in minutes.
   For all workers, the cost of driving an automobile is NRs.60.0 with a travel time of 20 minutes, and the bus fare is NRs.10.0 with a travel time of 25 minutes.
9. An eastbound urban corridor is composed of a two freeway. The first freeway is given by t1 = 5+3(q1/c1) where c1 is the freeway capacity of 3000vph, t1 is the travel cost in minutes and q1 is the volume using the freeway in vph. The second freeway has a performance function given by t2= 6+2(q2/c2) where c2 is the capacity in vph. The flow on the second freeway can be described by a Greenshield relationship of the form V = 100 - 0.725K, where V is the speed in kmph and K is the density in veh/km. If the total demand from the main line is 4000vph. What would be the volumes and travel times on both freeways under System optimization?
10. Write short notes on
    a) Differences between Production-Attraction matrix and Origin-Destination matrix.
    b) Generalized cost of travel

***

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2078 Chaitra

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

Subject: - Traffic and Transport Modeling *(Elective II) (CE76510)*

- ✓ 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 table is attached herewith.***
- ✓ *Assume suitable data if necessary.*

1. What are the major traffic issues in cities of Nepal? What is induced demand? Explain with an example. [8]
2. Define sampling with its type. A police officer observes that 5 out of 20 motorbikes violating the speed limit in Koteshwor – Suryabinak road section is apprehended. What is the probability that a driver who violates the speed limit 15 times per month will be apprehended once, not at all and more than once? [2+6]
3. Explain the various errors in modelling and forecasting process. A survey was carried out to determine spot speed of vehicle at Singadurbar – Bhadrakali section. The previous studies suggest that the standard deviation on the average speed will be almost 5 kmph. The team wants to obtain the average speed within error of 1 kmph with probability of 0.95. Determine the sample size for the observation. [4+4]
4. Explain the household interview method of transportation survey. What are the various inventories of transportation facilities, land use and economic activities? [4+4]
5. Trip rate corresponding to household (HH) size is shown in the table. Model the relationship between HH size and trip, and also check its statistical significance. Take 't' value for 3 degrees of freedom at 5% level of significance as 2.53. [8]

HH Size	Trips per day		
1	1	2	2
2	2	4	3
3	4	5	3
4	6	7	4

6. Distribute future year trips using Fratar growth factor method. Perform two iterations (at least). [8]

Origin	Destination			Base Year	Future Year
	1	2	3		
1	-	10	12	22	60
2	10	-	14	24	72
3	12	14	-	26	39
Base Year	22	24	26		
Future Year	60	72	39		

7. A mode choice model for a city includes following modes: Autos(A), Light rail (L), buses (B) and Rapid rail (R) with the utility function (U) as shown in tables.

Function	Cost (C)	Time (T)
$U(A) = 3.2 - 0.3\times C - 0.04\times T$	5	30
$U(L) = 1 - 0.3\times C - 0.04\times T$	3	25
$U(B) = 0 - 0.1\times C - 0.01\times T$	2.5	40
$U(R) = 1.5 - 0.3\times C - 0.05\times T$	6	20

Where C is cost in dollars and T is time in minute.

a) Based on estimate that 12,000 workers will head for downtown each morning, how many workers will choose to take a particular mode?

b) If government subsides light rail by 40%, buses by 25%, and rail rapid by 15% and the same time increases automobile cost by 30%, what will be the new modal distribution? [8]

8. During the peak-hour, a total of 4500 vehicles travel from the suburb to the city. Route 1 has 96.5 kmph speed limit and is 9.65 km in length. Route 2 is 4.83 km in length with 72.4 kmph speed limit. Studies show that the total travel time on route 1 increases two minutes for every additional 500 vehicles added. Minutes of a travel time on route 2 increases with the square of the number of vehicles, expressed in thousands of vehicles per hour. Determine the system optimal travel times. [8]

9. Discuss trip and its classification. Differentiate between Trip end model split model and tip interchange model split model. [4+4]

10. Write short notes on: [2×4]

a) O–D Studies

b) Multipath assignment and capacity restraint assignment

***

T-table

t-table	two-tails	one-tail	DF	1	2	3	4	5	6	7	8	9	10
α	0.1	0.05		6.314	2.920	2.353	2.131	2.015	1.943	1.895	1.860	1.833	1.812
	0.05	0.025		12.706	4.303	3.182	2.776	2.571	2.447	2.365	2.306	2.262	2.228

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2077 Chaitra

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

Subject: - Traffic and Transport Modeling *(Elective II) (CE76510)*

- ✓ 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. Discuss the system approach of transport planning. Discuss the role of model in transportation planning.
2. Perform a hypothesis test using $\alpha = 0.05$ to determine if the average time to issue ticket at counter 1 is more than the average time to pass through counter 2. The following table summarizes in seconds the results of two random samples from ticket counter.

Sample Statistics	Counter 1	Counter 2
Mean	15	12
Standard deviation	6	5
Sample size	25	30

   Assume the population variances for time through security at these two locations are equal.
3. List various types of errors in modeling. Describe any four of them with appropriate examples.
4. Why is traffic forecasting done? A bus service links a suburban community with the downtown area of a city. When the average bus travel time was 1.50 hours, bus ridership was 4200 passengers. With the current average bus travel time of 1 hour, bus ridership is 5100 passengers. A new improvement measures for public bus is being planned that this will reduce the bus travel time to 45 minutes. What is the expected demand of bus after the project is implemented? If the bus fare was Rs. 25 and Rs. 30 when bus ridership was 4200 and 5100 respectively. After the improvement price will be Rs. 35, estimate the demand considering both time and price effect.
5. Explain the need of inventory survey in transportation. Discuss the inventory of land use and economic activities.
6. A small town consisting of 10 zones was surveyed to find the number of shopping trips made by households of various sizes. The results are given below

Zone	1	2	3	4	5	6	7	8	9	10
Trips	4	1	3	2	2	2	3	4	1	2
HH size	6	2	4	3	4	4	6	3	2	4

   a) Set up a linear regression equation.
   b) Find correlation coefficient, coefficient of determination and interpret the results.

7. The following trip productions and attractions are given for a small urban area consisting of three travel analysis zones (TAZ):

Zone	A	B	C
Trip Attraction	300	700	100
Trip Production	500	200	400

The travel times between zones (Wij) are symmetric and are the followings:
Zone A to/from Zone B: 35 minutes
Zone A to/from Zone C: 15 minutes
Zone B to/from Zone C: 25 minutes

The friction factor (F) between the zones can be calculated using $F_{ij}=\frac{1}{W_{ij}^{c}}$ where the value of C was calibrated based on travel surveys and takes value of 0.7. The K factors can be assumed to be equal to 1.15 for all zonal pairs. Based on the provided inputs, calculate number of trips (trip flows) between all zonal pairs at least 2 iterations.

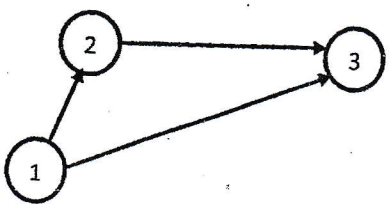
8. A market segment consists of 750 individuals in a travel analysis zone has three modes of travel with data provided in the table below. A multinomial logit model choice model calibrated for this market segment is as follows

$U = \beta - 0.35 \times C - 0.03T$, where T is travel time and C is out-of-pocket expense

a) Compute the mode split for the scenario.
b) If parking fee of $ 1.25 is imposed, how will the mode share change and why?

Mode	β	T [min]	C [$]
Auto	2.15	14	3.75
Rail	0.35	25	2.5
Bus	0.05	30	1.95

9. A total traffic flow of 600 units go from origin "1" to destination "3". There are two routes to go. "2" is a stop on one route. q_{12} means the traffic flow from 1 to 2: similar explanations apply to other variables. The travel time on each link is a function of the flow on the link, which is shown as follows:



Link	Time function
1 – 2	$2 \times q_{12}$
2 – 3	$20 + 3 \times q_{23}$
1 – 3	$5 \times q_{13}$

What is the user equilibrium assignment and equilibrium travel time from 1 to 3? What is the system optimal assignment?

10. Describe house hold interview survey including sampling strategies. What factors should be considered in designing questionnaire for interview?

***

TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2076 Bhadra

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

Subject: - Traffic and Transport Modeling *(Elective II) (CE76510)*

- ✓ 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 different types of decision making theories that can be applied in Transport modeling. [8]
2. The probability of vehicle arriving and turning left or right is 0.6 during 15 second at Baneshwor intersection. Find the probability that there will be 0, 1, 2, 3, or more vehicle arriving and going through (neither left nor right) in a minute of interval. [4+4]
3. List the various method of forecasting and explain in brief about forecasting based on past trend. [4+4]
4. List out the major information needed for transportation planning. What is home based survey and what types of information are collected through home based survey? [8]
5. Classify trips based on various category. What are the major factor that influence in the choice of a particular mode. [4+4]
6. Develop trip generation model for the following data and calculate and interpret coefficient of determination. Also calculate the trips corresponding to HH size of 8. [8]

Average HH size	2	3	4	5	6
Average total trips per day	5	7	8	10	10

7. A small study area has been divided into three zones and limited survey has resulted in the following trip matrix:

Zone	1	2	3
1	50	150	300
2	100	50	100
3	200	250	20

Estimated for future total trip generation for each zone are as given below:

Zones	Future Trip Origin	Future Trip Destination
1	460	400
2	400	500
3	602	702

Use Furness method to estimate future inter-zonal movements up to two iterations. [8]

8. A calibrated cost function for travel in a medium sized city by car, bus and rail is $C = A + 0.002*X + 0.05*Y$
Where X=travel cost (Rs) & Y = Travel time (minute)

Mode	A	X	Y
Car	0.3	500	30
Bus	0.35	75	60
Rail	0.4	150	45

Calculate modal split for the given values.
If a parking fee of Rs 200 is imposed, what would be the effect on modal share? [8]

9. There are two routes A and B to reach the destinatior with following features:

Route	Travel time at Zero flow	Maximum Capacity
A	10	2000
B	15	4000

Distribute 4500 vehicular trips using incremental techniques with three equal increments. Use BPR method to calculate travel time for corresponding flow. Take α=0.5 and β=4. [8]

10. Write short notes on: ***(Any Two)*** [4×2]
    a) Elasticity model
    b) Wardrop Principle of Route Choice
    c) Generalized cost function

***

05 J TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2075 Bhadra

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

Subject: - Traffic and Transport Modeling *(Elective II) (CE76510)*

- ✓ 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. Explain the issues that are to be dealt in transport modeling.
2. At a specified point on a highway, vehicles are known to arrive according to a Poisson process. Vehicles are counted in 20-second intervals, and vehicle counts are taken in 120 of these time intervals. It is noted that no cars arrive in 18 of these 120 intervals. Calculate the number of these 120 intervals in which exactly three cars arrive.
3. Explain the different types of errors during the process of modeling. Discuss elasticity model of traffic forecasting.
4. What are the factors to be considered in transport studies? Explain the base year inventories needed for transport modeling.
5. What are the advantages of cross classification method over growth factor method of trip generation? What is trip balancing and why is it needed?
6. Consider the following trip attraction models estimated using a standard computing package (t-ratios are given in parentheses)

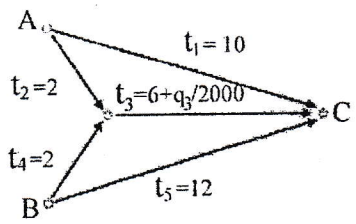
$$Y = \underset{(5.2)}{123.2} + \underset{(7.3)}{0.89X_1} \qquad R^2 = 0.900$$

$$Y = \underset{(6.4)}{40.1} + \underset{(1.9)}{0.14X_2} + \underset{(2.4)}{0.61X_3} + \underset{(1.8)}{0.25X_4} \qquad R^2 = 0.925$$

$$Y = \underset{(-0.6)}{-1.7} + \underset{(9.9)}{2.57X_1} - \underset{(-9.3)}{1.78X_4} \qquad R^2 = 0.996$$

where Y are work trips attracted to the zone, X_1 is total employment in the zone, X_2 is industrial employment in the zone, X_3 is commercial employment in the zone and X_4 is service employment. Choose the most appropriate model, explaining the reason.

7. Consider the transport network below with two origins (A and B) and one destination (C). The travel demand from A to C is 5.000 veh/h and the travel demand from B to C is 10000 veh/h. The network consists of five links. Only on link 3 congestion can occur, on all other links it is assumed that the capacity is sufficient to accommodate all traffic. The travel times min. as a function of the link flows veh/h are given in the figure for to each link? In a user equilibrium assignment, how many vehicles will use each of the links?



8. A market segment consists of 700 individuals. A multinomial logit mode choice model is calibrated for this market segment, resulting in the following utility function:

$$u = \beta_m - 0.35C - 0.015T$$

Where C = out of pocket cost and T = travel time, min. Values of β_m are

bus transit	0.00
rail transit	0.60
auto	1.80

for a particular orgin-destination pair, the cost of an auto trip, which takes 10 min, is 2.80, Rail transit trips, which take 15 min, cost is 2.00. Bus transit takes 25 min and costs 1.50. Predict the number of trips from this market segment that use each mode.

9. Explain how different factors affect mode choice. Describe the route choice behavior.

10. Consider two zones with the following data:

	number of inhabitants	number of jobs
Zone A	1000	300
Zone B	800	20

The number of inhabitants has been determined with a higher precision than the number of jobs. On average, the number of departing trips is 0.25 per inhabitant, and the number of arriving trips is 0.8 per job. All the travel resistances (intrazonal and interzonal) may be assumed equal. Determine the trip distribution.

a. elasticity model
b. land use transport cycle

***

05J TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2074 Magh

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

Subject: - Traffic and Transport Modeling *(Elective II) (CE76510)*

- ✓ 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 model? Explain the factors that affect the choice of modeling approach.
2. At a specified point on a highway, vehicles are known to arrive according to a Poisson process. Vehicles are counted in 20-second intervals, and vehicle counts are taken in 120 of these time intervals. It is noted that no cars arrive in 18 of these 120 intervals. Estimate the percentage of time headways that will be 10 seconds or greater and those that will be less than 6 seconds.
3. What practical constraints are to be considered in sampling? Discuss elasticity model of traffic forecasting.
4. Explain the base year inventories needed for transport modeling.
5. How trip classification affects trip distribution? What is trip balancing and why is it needed?
6. The number of shopping trips on Saturday and the corresponding household sizes are shown in table below. Compute the trip rate if the average household size is 3.5.

HH no.	Trips	People in HH
1	3	4
2	1	2
3	1	3
4	5	4
5	3	2
6	2	4
7	6	8
8	4	6
9	5	6
10	2	2

7. Two roads begin at a gate entrance to a park and take different scenic routes to a single main attraction in the park. The park manager knows that 4000 vehicles arrive during the peak hour, and he distributes these vehicles among the two routes so that an equal number of vehicles take each route. The performance functions for the routes are $t_1 = 10 + x_1$ and $t_2 = 5 + 3x_2$, with the x's expressed in thousands of vehicles per hour and the t's in minutes. How many vehicle-hours would have been saved had the park manager distributed the vehicular traffic so as to achieve a system-optimal solution?

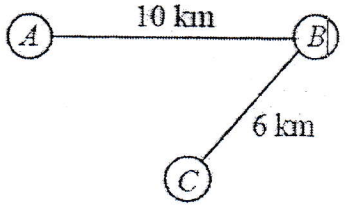
8. A simple work-mode–choice model is estimated from data in a small urban area to determine the probabilities of individual travelers selecting various modes. The mode choices include Motorbike (M), Car Sharing (CS), and bus (B), and the utility functions are estimated as

$$U_M = 2.2 - 0.2\,(\text{Cost}) - 0.03\,(\text{Travel time})$$
$$U_{CS} = 0.8 - 0.2\,(\text{Cost}) - 0.03\,(\text{Travel time})$$
$$U_B = -0.2\,(\text{Cost}) - 0.01\,(\text{Travel Time})$$

Where cost is in unit and time is in minutes. Between a residential area and an industrial complex, 4000 workers (generating vehicle-based trips) depart for work during the peak hour. For all workers, the cost of driving an automobile is 6 unit with a travel time of 20 minutes, and the bus fare is 1 unit with a travel time of 25 minutes. If the shared-ride option always consists of two travelers sharing costs equally, how many workers will take each mode? A bus company is making efforts to increase work-trip bus usage by constructing an exclusive bus lane that reduces bus travel time to 10 minutes and shared-ride vehicles are also permitted to use the facility what kind of change in mode choice occurs?

9. Explain the factors that affect the choice of a particular mode. Why transit trip assignment is more complex than other vehicular trip assignment?

10. Consider three villages, A, B, and C. The roads connecting the villages are indicated in the figure below where each road is bi-directional. The distances are indicated in kilometers. Furthermore, the production and attraction per zone is given in the table below. Assume that there is no intrazonal traffic. Distribute the trips by doubly constrained gravity model. (One full iteration needed)



zone	production	attraction
A	200	150
B	500	400
C	100	250

***

5J TRIBHUVAN UNIVERSITY
INSTITUTE OF ENGINEERING
Examination Control Division
2073 Bhadra

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

Subject: - Traffic and Transport Modeling *(Elective II) (CE76510)*

- ✓ 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 model. Briefly list the major four transportation related problems appearing in Kathmandu Valley. Explain how you can get rid of those problems. [2+2+4]
2. Nepal Yatayat driver drives 6000 km during the entire year. The probability of having crash is 100 per 200 million vehicle-kms. What is the probability of driver having at least 2 crashes during his driving carrier of 20 years? [8]
3. Explain the household interview method of transportation survey. Explain Stated and Revealed Preference Survey with examples. [4+4]
4. A calibrated cost function for travel in a medium sized city by motorcycle, bus and rail as $A + 0.002X + 0.05Y$ where X = travel cost (cent) and Y = Travel time (minute). Calculate modal split for the given values. What would be the result if government imposes parking fee of $1 (100 cent), subsidy rail fare by 40% and bus fare to 40%. [8]

Mode	A	X	Y
Motorcycle	0.3	130	25
Bus	0.35	75	35
Rail	0.4	90	40

5. Describe Zoning and Networking. A survey was carried out to determine spot speed of vehicle at Singadurbar-Bhadrakali section. The previous studies suggest that the standard deviation on the average speed will be almost 10 kmph. The team wants to obtain the average speed within error of 2 kmph with probability of 0.95. Determine the sample size for the observation. [4+4]
6. Distribute future year trips using Fratar growth factor method. Perform two iteration (at least). [10]

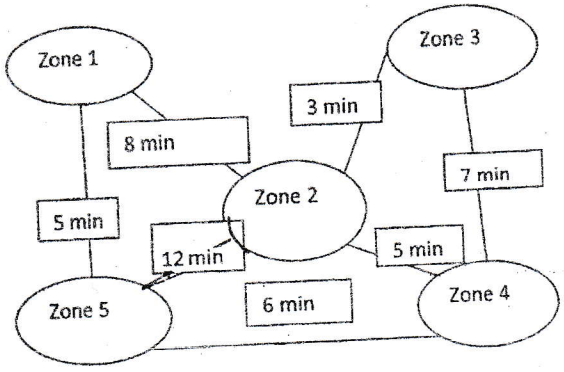
Origin	Destination			Base Year	Future Year
	1	2	3		
1	-	10	12	22	60
2	10	-	14	24	72
3	12	14	-	26	39
Base Year	22	24	26		
Future Year	60	72	39		

7. Define traffic forecasting and explain its importance in transportation planning. [2+4]

8. Trips corresponding to HH size are shown in adjacent table. Compute the trip rate corresponding to average household size of 2.5. Also check for statistical significance of the developed model. Check with T value of 3.20 for 95% confidence interval. [8]

HH size	Trips per day		
1	1	3	3
2	3	4	5
3	4	4	6
4	5	6	7

9. Assign the vehicle trips shown in O-D trip table to the network shown using "All-or-Nothing" technique. Also calculate the total vehicle minute of travel. [8]



Origin	Destination				
	1	2	3	4	5
1	-	100	100	200	150
2	400	-	200	100	500
3	200	100	-	100	150
4	250	150	300	-	400
5	200	100	50	350	-

10. What are the factors that influence the choice of particular mode? Explain briefly the statistical tools used in transport modeling. [4+4]

***

05J 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: - Traffic and Transport Modeling *(Elective II) (CE76510)*

- ✓ 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 transport planning process. What is the major role of traffic engineering? [8]
2. The data shows the occupancy of the parking space in a parking lot consists of 50 spaces. The count was taken as 15 min interval during the 4 hr duration between 11 am to 3 pm on 6 weeks day. Verify whether the no. of vacant space during any count follows a poison's distribution. [8]

Occupancy of parking space	Frequency
50	6
49	15
48	21
47	20
46	15
45	10
44	5
43	2
42	1
41	1
40 or less	0

3. Discuss about the importance of traffic forecasting. List the various method of forecasting and explain in brief about classical four step modeling. [3+5]
4. List the various method used for transportation survey. What are the various inventories of transportation facilities, land use and economic activities? [4+4]
5. A calibrated cost function for various modes; Auto (A), Micro (M), Bus (B) and Rail (R) for a certain city is summarized in the adjustment table. [4+4]

Mode	Calibrated Cost Function	Cost (C) in Dollar	Time (T) in minute
Auto	0.3*C+0.04*T-3.2	5	30
Micro	0.3*C+0.04*T-1	3	25
Bus	0.1*C+0.01*T	2.5	40
Rail	0.3*C+0.05*T-1.5	6	20

Calculate the model split at present condition. If government subsides cost of light rail by 30% and buses to 80% and the same time increases automobile cost by 15%, what will be the new modal distribution?

6. The population of a particular zone is divided into two categories: low and high income; and two modes; bus and bike. The random probability distribution is as follows: [5+3]

Transportation mode	Low income (LI)	High income (HI)
Bus	0.45	0.15
Bike	0.2	0.2

If 75% of population are low income population, find probability distribution for stratified and choice based method. What is the probability that the bus is being used by low income persons?

7. The number of work trips produced in and attracted to three zone 1, 2 and 3 by public transit are as under: [8]

Zone	1	2	3
Trip Produced (P_i)	14	33	28
Trip Attracted (A_j)	33	28	14

The friction-factors values between the various zones, obtained as a result of calibration can be taken from the following matrix.

P \ A	1	2	3
1	13	82	41
2	50	26	39
3	50	20	41

Distribute the trips between the zones taking the zone to zone socio-economic adjustment factors $K_{ij} = 1$ by apply gravity model (Only two iterations).

8. Trip rate corresponding to household (HH) size is shown in the adjacent table. Model the relationship between HH size and trip; and also check its statistical significance. Take 't' value for 3 degree of freedom at 5% level of significance as 2.53. [8]

HH size	Trips per day		
1	1	2	2
2	2	4	3
3	4	5	3
4	6	7	4

9. During the peak-hour, a total of 4500 vehicles travel from the suburb to the city. Route 1 has 96.5 km/h speed limit and is 9.65 km in length; Route 2 is 4.83 km in length with 72.4 km/h speed limit. Studies show that the total travel time on route 1 increases two minutes for every additional 500 vehicles added. Minutes of a travel time on route 2 increase with the square of the number of vehicles, expressed in thousands of vehicle per hour. Determine the system optimal travel times. [8]

10. Write short notes: [4+4]

a) Factors affecting Trip Generation
b) Minimum path with capacity restraints

***

05F 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: - Traffic and Transport Modeling *(Elective II) (CE76510)*

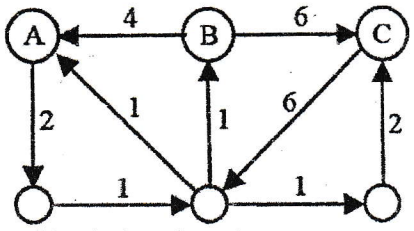
- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ *Attempt **All** questions.*
- ✓ *The figures in the margin indicate **Full Marks**.*
- ✓ *Assume suitable data if necessary.*

1. What is model? Explain how different factors affect the choice of modeling approach. [2+6]
2. An observer counts 360 vehicles/hr at a specific highway location. Assume that the vehicles arrivals are Poisson distributed. What is the probability that the gap between successive vehicles will be less than 7 seconds? What is the probability that the gap between successive vehicles will be between 7 and 10 seconds. [8]
3. Shortly describe the elasticity model for traffic forecasting. An engineer wishing to obtain the speed characteristics on a road in her city at a confidence level of 95% and an acceptable level of ± 1 *kmph* collected a total of 120 spot speed samples and determined that the variance is 25 $(kmph)^2$. Has the engineer met with all the requirements of the study? [4+4]
4. Explain the base year inventories needed for transport modeling. [8]
5. Classify the trips and explain how generations and attractions are balanced. Explain the generalized cost function. [4+4]
6. A small study area represented by six traffic zones has the following characteristics.

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

Formulate a trip production model and calculate relevant statistics for its significance. The value of t statistics for 3 degree of freedom at 5% level of significance is 2.353. [8]

7. Consider the following transportation network consisting of 6 nodes and 9 directed links with corresponding costs. Three nodes serve as an origin node as well as destination node where trip production and attraction takes place. For the intrazonal trips assume the travel impedance as 1.



Zone	Residents	Jobs
A	400	250
B	200	250
C	500	250

The trip production and attraction can be calculated using zonal data summarized below. The no. of trips produced per zone is 0.6 per residents and the number of trips attracted is 0.8 per job. Assume that the distribution function is given by $f(C_{ij}) = {}^{1}/_{C_{ij}}$ where C_{ij} is the cost from zone i to zone j. Determine the O-D trip matrix by applying gravity model (only one iteration). [8]

8. Write down the different factors affecting mode choice. What are the differences between multipath assignment and incremental traffic assignment? [4+4]
9. Given the utility equation

$$U_k = a_k - 0.003X_1 - 0.04X_2$$

Where X_1 is the travel cost in rupees and X_2 is the travel time in minutes. Calculate the market shares of the following travel modes. [8]

Mode k	a_k	X_1	X_2
Car	-0.20	120	30
Express bus	-0.40	60	45
Regular bus	-0.60	30	55

Also estimate the effect that a 50% increase in the cost of all three modes will have on modal split.

10. An eastbound urban corridor is composed of a freeway splitting into two freeways running in parallel as shown. The performance function of the first freeway is given by $t_1 = 4 + 3\left(\frac{q_1}{C_1}\right)$ where C_1 is the freeway capacity of 2500 vph, t_1 is the travel cost is minutes and q_1 is the volume using the freeway in vph. The second freeway has a performance function given by $t_2 = 6 + 2\left(\frac{q_2}{C_2}\right)$ where C_2 is the capacity in vph. The flow on the second freeway can be described by a Greenshield relationship of the form V=100-0.625K, where V is the speed in kmph and K is the density in veh/km. if the total demand from the main line upstream of the bifurcation is 2500 vph and the total onramp flow is 1000 vph.

What would be the volumes and travel times on both freeways downstream of the bifurcation under user equilibrium? [8]

***

05J 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: - Traffic and Transport Modeling *(Elective II) (CE76510)*

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

1. Explain the characteristics of transport problem? Also describe the model developing process. [4+4]
2. The observed mean headway is 3.5 seconds and standard deviation is 2.6 seconds. Compute the probability that the headway lies between 0 and 0.5 seconds. Assume that expected headway is 0.5 seconds. [8]
3. What are the different types of errors in modeling? Explain briefly the traffic forecasting methods. [4+4]
4. What are the base year inventories needed for transportation modeling? Explain in brief the home interview survey. [2+6]
5. Describe the factors affecting trip generation? Explain P-A matrix and O-D matrix. [4+4]
6. A trip production regression equation was developed using some data and the resulting equation is:

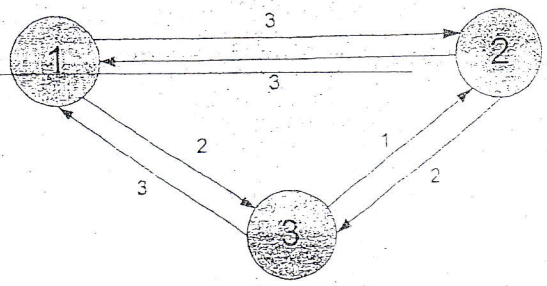
$$O_i = 0.091 + 0.735(size)_i + 0.945(CO)_i$$

Where
O_i= total daily trips per household produced in zone i
$(size)_i$= average household size in zone i
$(CO)_i$= average car ownership level in zone i
Forecasted number of households

Family size	Car ownership		
	0	1	2 or more
1	24	42	8
2	10	51	107
3	11	31	158
4 or more	3	17	300

Compute the total daily trip productions for the given zone. [8]

7. A three zone have been connected by a transportation network as indicated in the figure below. The number next to each link represents the travel cost. Assume all intra-zonal travel cost as 1. The total trip production and attraction of all zones are given in the table.



Zone	Production	Attraction
1	200	320
2	300	265
3	350	265

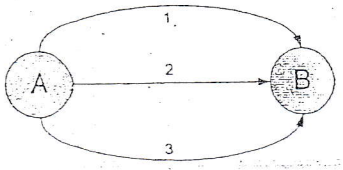
Determine the OD trip matrix using gravity model using accessibility $F_{ij} = f(c_{ij}) = 5 \times e^{(-0.5c_{ij})}$ as the trip distribution function. (Perform only two iterations). [8]

8. Elaborate the factors that affect mode choice? Explain transit trip assignment. [4+4]

9. The total number of trips from zone i to zone j is 5000. Currently all trips are made by car. Government has two alternatives: to introduce a train or a bus. The travel characteristics and respective coefficients are given in table below. Decide the best alternative in terms of trips carried. [8]

	t_{ij}^{v}	t_{ij}^{walk}	t_{ij}^{t}	F_{ij}	$\emptyset_{ij}$
Coefficient	0.05	0.04	0.07	0.2	0.2
Car	25	-	-	22	6
Bus	35	8	6	8	-
Train	17	14	5	6	-

10. Consider the following transport network from city A to B consisting of three non-overlapping routes. Each route consists of a single link. The travel demand from A to B is 3000 travelers.



Let the flow on each link be denoted by q_a where a = 1, 2, 3. The travel time functions $t_a(q_a)$ are given by the BPR function. The parameters for each link are given in the table below.

Link	t_a^0	C_a	$\propto_a$	β_a
a=1	10	1000	1	1
a=2	8	1000	2	1
a=3	12	6000	0	1

Determine the flows in an all-or-nothing assignment. What will be the travel time functions given by BPR method. [8]

***

170 copies
07/04/23

053 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 and Transport Modeling *(Elective II) (CE76510)*

- ✓ 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 a model? Describe model calibration and validation process. [2+6]
2. What are the inventories related to transportation facilities and economic activities? Discuss in brief about the Home Interview Survey. [4+4]
3. Describe the various types of sampling methods. What are the factors to be considered during zoning the certain area? [4+4]
4. A mode choice model for a certain city includes four modes: Auto (A), Rail (R), Micro (M) and Bike (B) with the following utility function (U) as shown in the following table. [8]

Utility Function	Cost (C)	Time (T)	Constant (P)
U(A) = P – 0.3 * C – 0.04 * T	5	30	3.2
U(R) = P – 0.3 * C – 0.04 * T	3	25	1
U(M) = P – 0.1 * C – 0.01 * T	2.5	40	0
U(B) = P – 0.3 * C – 0.05 * T	6	20	1.5

Determine the usage of each mode if there are altogether 10,000 trip maker in a day.

5. Discuss about the advantages and disadvantages of growth factor method of trip distribution and also mention the factor affecting mode choice. [4+4]
6. At an uncontrolled T junction, past experience indicates that the probability of a vehicle arriving on the side of road during a 20 second interval and turning right into a main road is 1/4. Find the probability that in a period of 1 minute there will be 1, 2, 3, 4 or 5 vehicles arriving and turning right. [8]
7. Explain different types of traffic forecasting models. Explain travel demand function. [4+4]
8. Enlist the problems that arise in application of regression analysis. Trip data from the study area is given in the Table 1. Find out the balancing factor and balance the number of work trips in the study area. [2+6]

Table 1. Number of works trips in the study area

Zones	Unbalanced work trips		Balanced work trips	
	Production trips	Attraction trips	Production trips	Attraction trips
1	100	4000		
2	300	3000		
3	500	5000		
4	1500	1200		
5	1000	1000		
6	1000	1500		

7	5000	500		
8	7000	500		
9	3000	1500		
10	2000	2500		
Sub totals	21400	20700		
External stations				
11	500	50		
12	1000	100		
13	250	25		
Sub total	1750	175		
Total	**23150**	**20875**		

9. A town consists of four residential areas A, B, C, D and two industrial estates X and Y. Generation equations show that, for the design year in question, the trips from home to work generated by each residential area per day and the trips attracted in each industrial area per day are as follows. [8]

Residential Zones	Trip Production	Industrial Zones	Trip Attraction
A	3200	X	4500
B	1750	Y	3700
C	2250		
D	1000		

It is known that the attraction between zones is inversely proportion to the square of the journey time between zones. The journey times in minutes from the home to work are:

Zones	X (minutes)	Y (minutes)
A	15	20
B	15	10
C	10	10
D	15	20

Calculate and tabulate the interzonal trips for journeys from home to work. Perform only two iterations.

10. Explain different types of trip assignment models? In order to relieve congestion on an urban street network a motorway is proposed to be constructed. The travel time from one zone centroid to another via the proposed motorway is estimated to be 20 minutes whereas the time for the same travel via existing street is 25 minutes. The flow between the two zone centroids is 800 vehicles per hour. Assign the flow between the new motorway and existing streets. [4+4]

***