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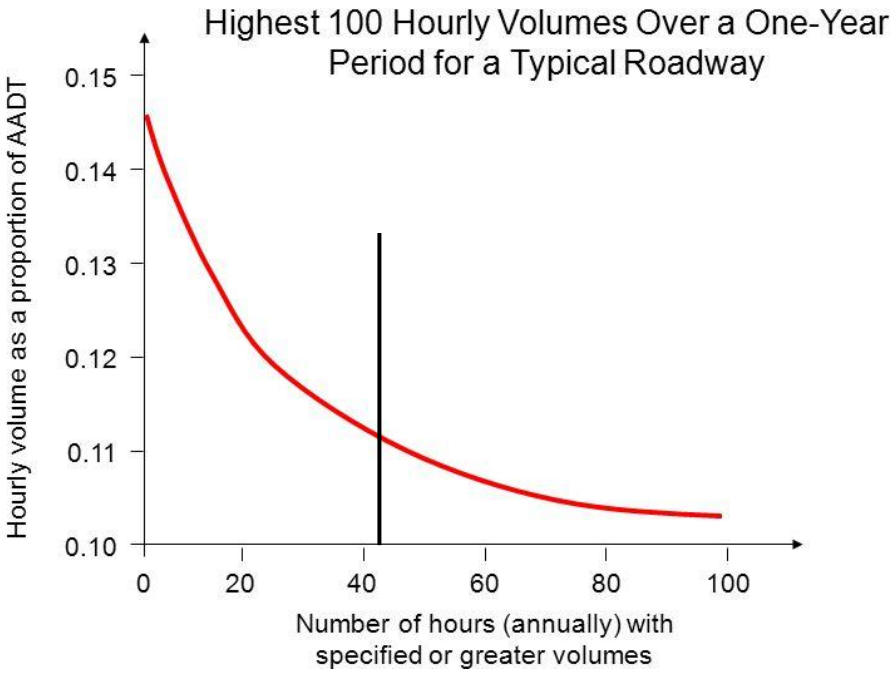
Solution to Internal Assessment Test II – Nov. 2017

Sub:	TRAFFIC ENGINEERING	Sub Code:	10CV561	Branch:	CIVIL

Answer any **TWO FULL** Questions from **PART A** and **PART B** is compulsory

		MARKS	CO	RBT
	PART A			
1 (a)	Write a short note on 30th highest hourly volume and explain its significance.	[05]	CO2	L2
	Explanation -1.5 Sketch-2 Significance-3			

Thirtieth highest hourly volume is the hourly volume that will be reached only thirty times in a year or exceeded only 29 times in a year and all other hourly volumes of this year will be less than this value.



Significance: the highway facility design with respect to 30th highest hourly volume is found to be satisfactory with respect to consideration of facility as well as cost. This is because cost is less when compared to peak hourly volume and there will be congestion only 29 hours in a year which is a reasonable measure.

(b)	With a neat sketch, indicate various elements of traffic rotary.	[07]	CO3 and CO4	L2
	Sketch – 2 5 elements- 5 marks			

Design speed

- The normal practice is to keep the design speed as 30 and 40 kmph for urban and rural areas respectively.

Entry, exit and island radius

- The radius at the entry depends on various factors like design speed, super-elevation, and

coefficient of friction.

- The entry radius of about 20 and 25 meters is ideal for an urban and rural design respectively.
- A general practice is to keep the exit radius as 1.5 to 2 times the entry radius.
- The radius of the central island which is about 1.3 times that of the entry curve is adequate for all practical purposes.

Width of the rotary

- IRC suggests that a two lane road of 7 m width should be kept as 7 m for urban roads and 6.5 m for rural roads.
- Further, a three lane road of 10.5 m is to be reduced to 7 m and 7.5 m respectively for urban and rural roads.
- The width of the weaving section should be higher than the width at entry (e1)and exit(e2).

Weaving length

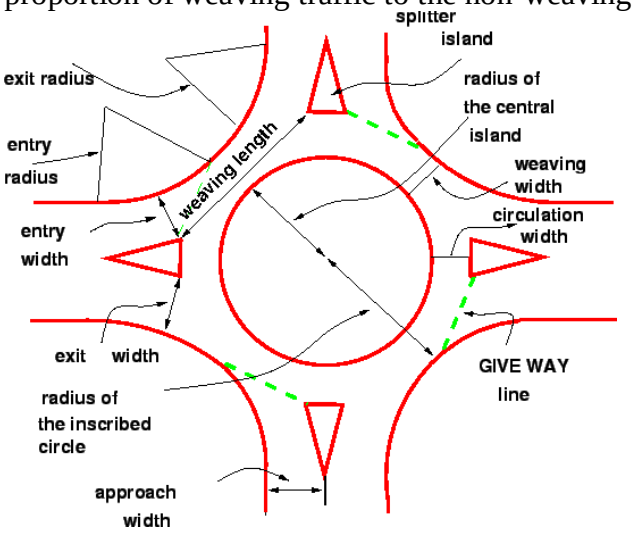
- It determines the ease with which the raffic can merge and diverge.
- To prevent direct traffic cuts, its desirable to make the ratio of weaving length to width large enough. A ratio of 4: 1 is considered as minimum.
- Minimum length of weaving section should be 45 or 30 for design speeds of 40 kmph and 30 kmph respectively.

Capacity

- The capacity of rotary is determined by the capacity of each weaving section.

$$Q_w = \frac{280w[1 + \frac{e}{w}][1 - \frac{p}{3}]}{1 + \frac{w}{l}}$$

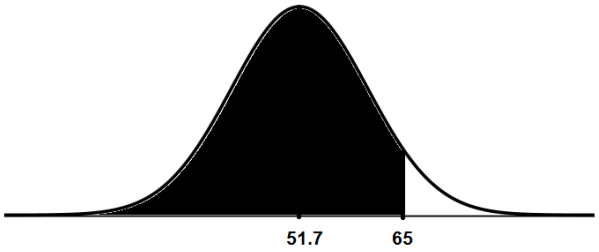
where e is the average entry and exit width = (e1+e2/2), l is the length of weaving, and p is the proportion of weaving traffic to the non-weaving traffic.



(c)	The spot speeds at a particular location are normally distributed with a mean of 51.7 kmph and standard deviation of 8.3 kmph. What is the probability that (i) the speeds exceed 65 kmph (ii) Speeds lie between 40 kmph and 70 kmph (iii)85th percentile speed. The values from normal distribution tables are ϕ (1.6) = 0.952, ϕ (2.21) = 0.9864, ϕ (1.41) = 0.9207, ϕ (Z) = 0.85 for which Z=1.04.	[08]	CO2	L2
	(i) the speeds exceed 65 kmph (2.5) (ii) Speeds lie between 40 kmph and 70 kmph (2.5)			

(iii) 85th percentile speed. (3)

(i) Speeds exceed 65 kmph

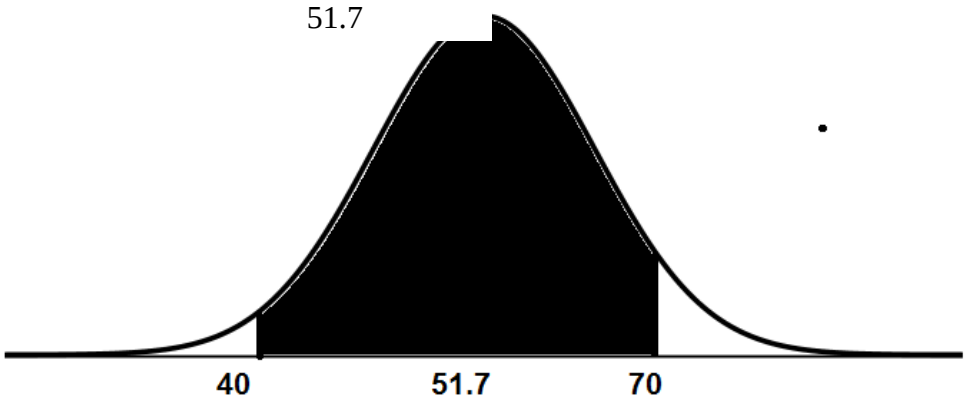


P(x>65) = 1-P(x<65)

Standard variate = $\frac{65-51.7}{8.3} = 1.6$

P(x>65) = 1-P(x<65) = 1-0.952 = 4.8 %

(ii) Speeds lie between 40 kmph and 70 kmph



$$z40 = \frac{40 - 51.7}{8.3} = -1.41$$

$$z70 = \frac{70 - 51.7}{8.3} = 2.21$$

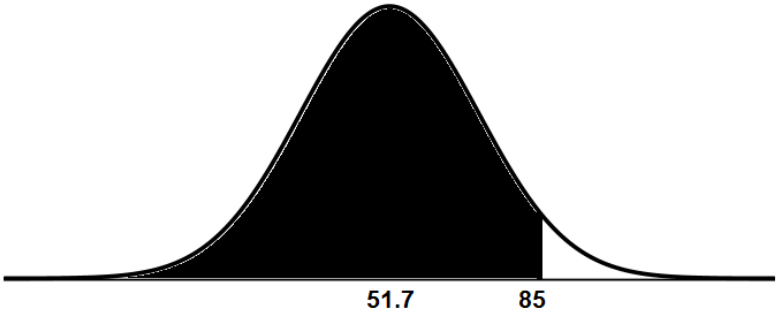
P (1- ϕ (1.41) = 1- 0.9207 =0.0793

P(40 < x < 51.7) = 0.5-0.0793 = 0.4207

P(51.7 < x < 70) = 0.9864 - 0.5 = 0.4864

P(40 < x < 70) = 0.4207+ 0.4864 = 90.71%

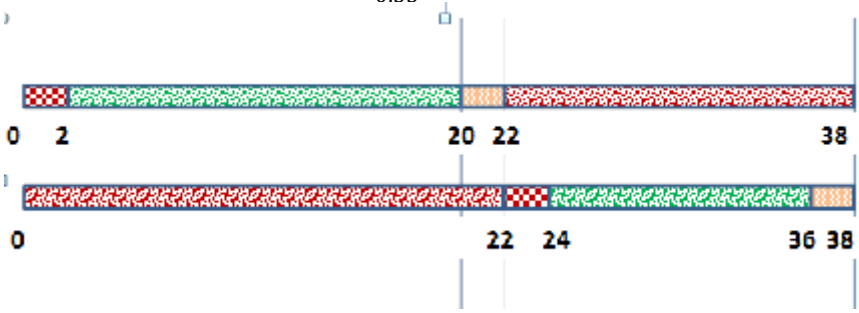
(iii) 85th percentile speed



ϕ (Z) = 0.85 for which Z=1.04

$$z40 = \frac{x - 51.7}{8.3} = 1.04$$

x = 60.3 kmph

2 (a)	Explain the objectives of O and D studies.	[05]	CO2	L1
	Minimum 5 points – 5 marks			
	The following objectives are identified: (i) To judge the adequacy of existing routes and to plan new network of roads. (ii) To establish design standards for th road, bridges and culverts along the route (iii) To locate expressways or major routes along the desire lines. (iv) To establish preferential routes for various categories of vehicle including by-pass. (v) To locate new bridges as per traffic demands (vi) To plan transportation system and mass transit facilities in cities including routes and schedules of operation. (vii) To locate terminals and to plan terminal facilities. (viii) To locate intermediate stops of public transport.			
(b)	A simple four leg intersection needs a fixed time signal. The critical flow in N-S and E-W directions is 600 and 400 veh/hr, saturation flow is 1800 veh/hr and the lost time per phase is observed to be 2 seconds and the amber period as 2 seconds. Determine the cycle length and distribution of green. Give a neat sketch of timings. Use Webster's method.	[07]	CO3	L3
	Lost time – 1.5 Estimation of cycle time -1.5 Effective green time -2 Phase diagram - 2			
	Assume, I =4 s A= 2 L= Total lost time = 2 × (4 - 2) + 2 × 2= 8 sec C_0 = Optimum cycle time = $\frac{1.5L+5}{1-y} = \frac{1.5\times8+5}{1-(0.33+0.22)} = 38$ sec. Effective green time = 38-8= 30 sec Effective green time for A = $\frac{0.33}{0.55} \times 30 = 18\ sec$ Effective green time for B = $\frac{0.22}{0.55} \times 30 = 12\ sec$			
				
(c)	Explain the various preventive measures to reduce accidents.	[08]	CO2	L2

	Three preventive measures Engineering (2.5) Enforcement (3) Education (2.5)			

The measures can be divided into 3 groups:
Engineering
Enforcement
Education

Engineering measures:
Road design
Improved geometric design like width of shoulders, width of road, intersection design elements
Pavement surface characteristics including skid resistance, suitable maintainence steps
Construction of by-passes, grade separated intersections or flyovers with suitable interchanges
Preventive maintenance of vehicles
Braking system, steering system, idicators, lighting system, condition of tyres etc are to be checked and heavy penalties should be levied on defective vehicles.
Before and after studies
Comparison of frequency and number of road accidents using condition and collision diagram before and after implementing regulations, enforcements or educational measures
Road lighting:
Reduce the road accidents occurring at nights due to poor visibility.
Enforcement measures
Speed control:
Installation of speed limit and warning signs
Checking over speeding of vehicles by means of surprise checks or by levying fines
Installation of tachometers in all public transport vehicles to record running speeds and the respective timings
Installation of speed breakers for control of vehicular speeds at intersections of major and minor streets, hospitals, schools, market area, residential areas etc.
Traffic control devices
Installation of different traffic regulatory measures like improved design of traffic signals, traffic signs, road markings etc.
Training and supervision
To be strict in issuing license to drivers, ensure renewal of driving license and check the physical fitness of driver etc
Medical check
Drivers should be tested for glare recovery time, vision, reaction time and colour blindness
Special precautions for commercial vehicles
To be insisted on having an attendant to give proper direction to drivers of heavy commercial vehicles and buses.
Observance of law and regulation
Check the enforcement of traffic regulations at selected locations
Education measures
Education of road users
Associating through NGO's and taking classes for school children on importance of road safety, use

	of posters for safe drive, educating passengers and pedestrains on traffic rules etc. Safety drive Organising "Traffic Safety Week" where the road users are educated on safe drive, shooting documentaries, organising training programmes or Highway Safety Workshops etc.			
3 (a)	Define PCU. What are the different factors affecting PCU.	[05]	CO3	L2
	PCU definition-1 Common values- 1 Factors- 3			

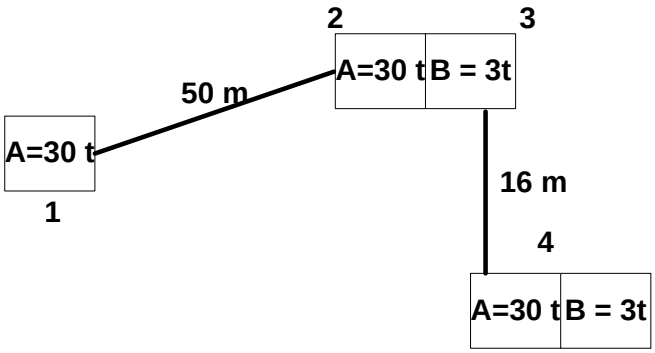
Passenger Car Unit (PCU) is a metric used in Transportation Engineering, to assess traffic-flow rate on a highway. A Passenger Car Unit is a measure of the impact that a mode of transport has on traffic variables (such as headway, speed, density) compared to a single standard passenger car. This is also known as passenger car equivalent. For example, typical values of PCU are:

Vehicle type	PCU
Car	1
Motorcycle	0.5
Bicycle	0.2
LCV	2.2
Bus, truck	3.5
3-wheeler	0.8

The different factors affecting PCU are

1. Average length and width of the vehicle
2. Average speed of the vehicle
3. Average transverse and longitudinal gap allowed between the vehicles
4. Traffic location – midblock, intersection, rotary etc
5. Parking on roads – reduce capacity of the road
6. Road geometrics like width of road, presence of median, footpaths, curves etc
7. Composition of traffic

(b)	A vehicle of weight 30 tonnes skids through a distance equal to 50 m, before colliding with another parked vehicle of weight 3 tonnes. After collision, both the vehicles skid through a distance equal to 16 m, before stopping. Determine the speeds of vehicles assuming f-0.4 (i) after collision (ii) at collision (iii) before collision.	[07]	CO2	L3
	After collision – (2) At collision –(3) Before collision- (2)			



After collision (path 3-4):

$u = v_{A3}$

$v = 0$

$v^2 = u^2 + 2aS$

$0 = (v_{A3})^2 - 2\times0.4\times9.81\times16$

$v_{A3} = 11.21$ m/s

At collision (path 2-3):

Principle of conservation of momentum

$WA\times v_{A2} + WB\times 0 = (WA + WB)\times v_{A3}$

$30\times v_{A2} + 3\times 0 = (33)\times 11.21$

$v_{A2} = 12.33$ m/s

Before collision (path 1-2):

$u = v_{A1}$

$v = v_{A2}$

$v^2 = u^2 + 2aS$

$12.33^2 = (v_{A1})^2 - 2\times0.4\times9.81\times50$

v_{A1} = 23.33 m/s

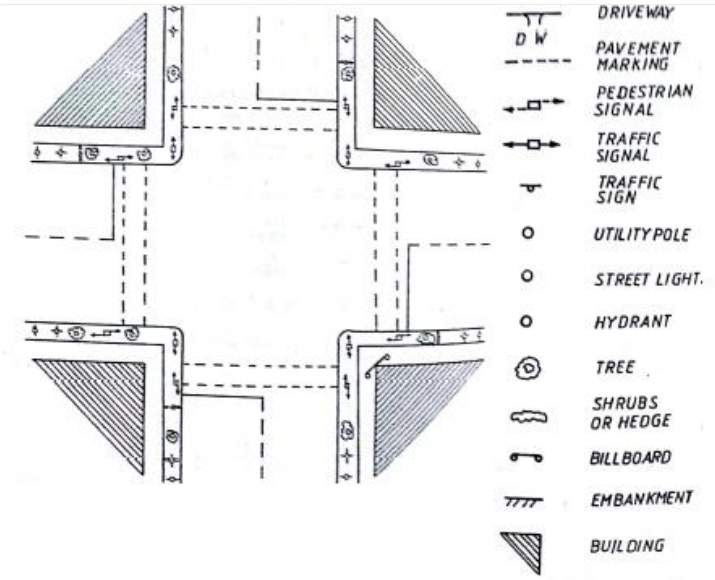
(c)	Explain with neat sketches Condition diagram and Collision Diagram.	[08]	CO2	L2
	Condition diagram – 4(2.5 theory+1.5 sketch) Collision diagram – 4 (2.5 theory+1.5 sketch)			

Condition Diagram:

This is a diagram of the accident location drawn to scale.

It shows important features of the road and adjoining area using standard symbols.

Important features include width of roadway, shoulders, median, curves, kerb lines, bridges, culverts, trees, electric post, traffic signs and signals

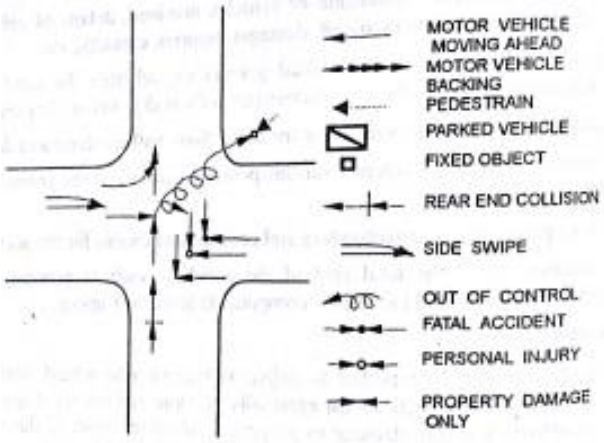


Collision diagram:

Depict the details of accident location, but not to scale using standard symbols.

Show the approximate path of the vehicles and pedestrians involved in the accident.

Collision diagram helps in comparing the accident pattern before and after reedial measures have been taken

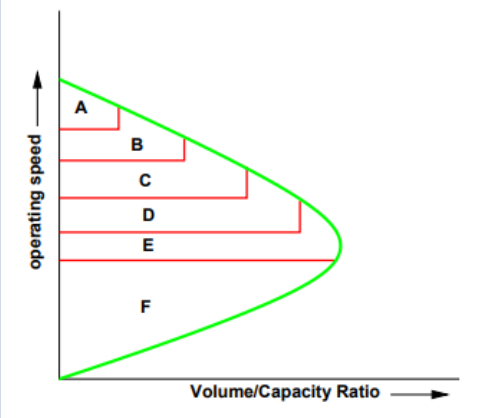


	PART B			
4 (a)	Write short notes on Level of Service.	[05]	CO2	L2
	Cocnept(1) Classification – (4)			

(i) Level of Service:

This is defined as a quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience.

- Six LOS are defined for each type of facility
- LOS are designated using letter A to F
- LOS A represents best operating conditions and LOS F is the worst
- Each LOS represents a range of operating conditions and the driver's perception of those conditions.
- Safety is not included in the measures to establish LOS

Performance measures	Operational measures
➢ Travel speed ➢ Traffic density ➢ Delays at signalized intersections ➢ Walking speed for pedestrians 	➢ Dependent upon type of facility. ➢ Also called as measure of Effectiveness (MOE) for each facility type ➢ Typically three parameters are used under this and they are speed and travel time, density, and delay

(b)	Explain the classification of Traffic signs. What are its advantages and disadvantages?	[05]	CO4	L2
	Different signs (3) Advantages and Disadvantages (2)			

- Mandatory Signs
- Cautionary Signs / Warning
- Informatory Signs

Mandatory Signs / Regulatory Signs

➢ These signs are used to inform road users of certain laws and regulations to provide safety and free flow of traffic.

➢ These include all signs which give notice of special obligation, prohibition or restrictions with which the road user must comply.

➢ The violation of these signs is a legal offence.

Compulsory Direction Control signs

This indicates that vehicles are obliged to proceed only in the directions indicated.

Cautionary Signs/ Warning signs

These are used to war the road users of certain hazardous conditions that exist on or adjacent to the roadway. They are in the shape of an equilateral triangle with its apex pointing upwards. They have a white background, red borer and black symbols.

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Informatory Signs:

These signs are used to guide road users along routes, inform them about destination and distance, identify points of geographical and historical interest and provide other information that will make

the road travel easier, safe and pleasant.

Advantages

- They control the flow of traffic making it easier for drivers and safer for pedestrians
- They reduce the risk of accidents
- They lower the chances of traffic jams
- Keep the roads safer
- Alert drivers on upcoming road conditions.

Disadvantage is that not everyone understands them, and they are not always enforced.

Signature of CI Signature of CCI Signature of HOD