	INSTRUCTIONS:													
	Fill out the hazard analys	is and risk assessment be	low.											
	HA-001 should be for the	lane departure warning fu	nction as discussed in the	lecture.										
	HA-002 should be for the	lane keeping assistance for	unction as discussed in the	lecture.										
			s for the lane assistance sy		nd HA-004 rows.									
	When finished, export yo	ur spreadsheet as a pdf fil	e so that a reviewer can eas	sily see your work.										
Hamand ID				Olfmatia mal Amalma	-									
Hazard ID				Situational Analysi						5 5	Hazard Identification			_
	Operational Mode	Operational Scenario	Environmental Details	Situation Details	Other Details (optional)	Item Usage (function)	Situation Description	Function	Deviation	Deviation Details	Hazardous Event (resulting effect)	Event Details	Hazardous Event Description	Exposure (of situation)
HA-001	OM03 - Normal Driving	OS04 - Highway	EN06 - Rain (Slippy Road)	SD02 - High Speed	L	U01 - Correctly Jsed	Normal driving on a highway during rain (slippery road) with high speed and correctly used system.	Lane Departure Warning (LDW) function shall apply an oscillating steering torque to provide the driver with haptic feedback		The LDW function applies an oscillating torque with very high rote (about limit)	EV - 00 Collision with other vehicle	High haptic feedback can affect driver's ability to steer as intended. The driver could lose control of the vehicle and collide with another vehicle or with road infrastructure.	The LDW function applies too high an oscillating torque to the steering wheel (above limit)	E3 - Medium probability
HA-002	OM03 - Normal Driving	OS03 - Country Road	EN01 - Normal conditions	SD02 - High Speed	ii ii	U01 - Incorrectly	Normal driving on a country road during	Lane Keeping	DV03 - Function	The lane keep assistance	EV - 00 Collision with	Because hands are's on the wheel	LKA system does not have a	E2 - Low
						Jsed	normal conditions with high speed and	' •	always activated	was always on and had no	other vehicle	at high speeds, a vehicle accident	time limit.	probability
							incorrectly used system.(the driver is mis-use	` ′		time limit.		would not be controllable, hence		
							the lane keeping assistance function as a	steering torque when				may lead to fatal accidents.		
							fully autonomous function)	active in order to stay in				,		
							,,	ego lane						
HA-003	OM03 - Normal Driving	OS04 - Highway	EN01 - Normal conditions	SD02 - High Speed		U01 - Correctly Jsed	Normal driving on a highway during Normal conditions with high speed and correctly used system.	Lane Keeping Assistance (LKA) function shall apply the steering torque when active in order to stay in ego lane	DV02 - Function unexpectedly activated	Camera ECU subsystem has give wrong signal that the vehicle is off the lane while it is NOT	EV - 00 Collision with	Unnecessary steering torque will cause accident vehicle collides.	Camera ECU subsystem sometime report incorrect and Annecessary lane departing signal.	E1 - Very low probability
HA-004	OM01 - Parked	OS06 - Off Road	EN01 - Normal conditions	SD07 - N/A	_	U01 - Correctly Jsed	Parked on a off road during Normal conditions with 0 speed and correctly used system.	Lane Keeping Assistance (LKA) function shall apply the steering torque when active in order to stay in ego lane	DV02 - Function unexpectedly activated	Lane keeping LKA still function with unnecessary steering torque when car is parked off road.	EV - 06 N/A	Unnecessary steering torque during parking.	LKA still give steering torque during parking	E1 - Very low probability

	Haza	ardous Event Classificat	ion		Determi	nation of ASIL and Safety Goals		
Rationale (for exposure)	Severity (of potential harm)	Rationale (for severity)	Controllability (of hazardous event)	Rationale (for controllability)	ASIL Determination	Safety Goal		
Driving on high way in rainy day usually the possibility is about 1-10%	S3 - Life-threatening or fatal injuries	It is fatal if collide on high speed.	C3 - Difficult to control or uncontrollable	Accident in high speed usually is our of control of driver.	С	The oscillating steering torque from the lane departure warning function shall be limited.		
This usually <1% of the total operational time in country road, plus with a high speed, the combination probability is not high.	S3 - Life-threatening or fatal injuries	Drive in high speed without hands on wheel and lane keeping assistance ON is fatal	C3 - Difficult to control or uncontrollable	Hands aren't on the wheel at high speeds, a vehicle accident would not be controllable.		The lane keeping assistance function shall be time limited, and the additional steering torque shall end after a given time interval so that the driver cannot misuse the system for autonomous driving.		
Very Seldomly happen, only get some reports	S3 - Life-threatening or fatal injuries	Unnecessary steering torque will cause vehicle collision	C3 - Difficult to control or uncontrollable	Driver may lose control of the vehicle when this Mal- function happen	A	Lane keeping assistance should be OFF when Camera ECU not function as expected.		
Very Seldomly happen, only get some reports	S0 - No injuries	Unnecessary steering torque may not hurt when car is parked	C3 - Difficult to control or uncontrollable	Driver may lose control of the vehicle when this Mal- function happen	QM	Lane keeping assistance should be OFF when park off road.		

				ituational Analysis	Other P. t. II	ltow Ha			
HA-001	Operational Mode Normal Driving	Operational Scenario City Road	Environmental Details Normal Conditions	Situation Details (optional) Low Speed	Other Details (optional) Night time + Obstacle on the	Item Usage (function) Correctly Used	Situation Description Normal Driving on a City Road in Normal	Function Low beam illuminates the	Peviation Function not activated
MORE EXAMPLES - Headlan	np System								
Hazard ID HA-001	Operational Mode OM03 - Normal Driving	Operational Scenario OS01 - City Road	Environmental Details EN01 - Normal conditions	Situation Analysis Situation Details (optional) SD03 - Low speed	Other Details (optional) Night time + Obstacle on the	Item Usage (function) IU01 - Correctly used	Situation Description Normal Driving on City Road during Normal	Function Low beam illuminates the	Deviation DV01 - Function not activate
HA-002 HA-003 HA-004 HA-005	OM03 - Normal Driving OM03 - Normal Driving OM03 - Normal Driving OM03 - Normal Driving	OS01 - City Road OS03 - Highway OS02 - Country Road OS02 - Country Road	EN04 - Snowfall (degraded view) EN04 - Snowfall (degraded view) EN01 - Normal conditions EN04 - Snowfall (degraded view)	SD03 - Low speed SD03 - High speed SD02 - High speed SD04 - High speed	Night time + Obstacle on the Night time + Obstacle on the Night time + Obstacle on the Night time + Oncoming Night time + Obstacle on the	IU01 - Correctly used IU01 - Correctly used	Normal Driving on City Road during Snowfall Normal Driving on Highway during Snowfall Normal Driving on Country Road during Normal Normal Driving on Country Road during Snowfall	Low beam illuminates the Low beam illuminates the Low beam illuminates the Low beam illuminates the	DV01 - Function not activate
				ober, ingrespect					

	I		

	I		

 , I		

· · · · · · · · · · · · · · · · · · ·			

Hazard Identi Deviation Details	tification Hazardous Event (resulting effect)	Event Details Hazardous Event Description	Exposure (of situation)	Rationale	Hazar Severity (of potential harm)	dous Event Classification Rationale (for severity)	Controllability (of hazardous event)
Both headlights stop working	(resulting effect) Front collision with obstacle	Vehicle crashes into the Total loss of low beam	(of situation) E4 - High probability	(for exposure) night driving in the city is a regular	(of potential harm) S1 - Light and moderate injuries	(for severity) In city traffiic, speed of vehicle is expected to be low	(of hazardous event) C0 - Controllable in general
Hazard Identi	tification				Цатаг	dous Event Classification	
Deviation Details Both headlights stop working	Hazardous Event (resulting effect) EV04 - Front collision with obstacle	Event Details Hazardous Event Description Vehicle crashes into the Total loss of low beam	Exposure (of situation) E4 - High probability	Rationale (for exposure) night driving in the city is a regular	Severity (of potential harm) S1 - Light and moderate injuries	Rationale (for severity) In city traffiic, speed of vehicle is expected to be low	Controllability (of hazardous event) C0 - Controllable in general
Both headlights stop working Both headlights stop working Both headlights stop working Both headlights stop working	EV04 - Front collision with obstacle EV04 - Front collision with obstacle EV08 - Collision with other vehicle EV04 - Front collision with obstacle	Vehicle crashes into the Total loss of low beam Vehicle crashes into the Total loss of low beam Vehicle crashes into the Total loss of low beam Vehicle crashes into the Total loss of low beam	E1 - Very low probability E2 - Low probability E4 - High probability E2 - Low probability	night driving in the city on High driving is part of regular country driving is part of regular country driving is part of regular	S1 - Light and moderate injuries S3 - Life-threatening or fatal injuries S3 - Life-threatening or fatal injuries S3 - Life-threatening or fatal injuries	In city traffiic, speed of vehicle is expected to be low On highway speed of vehicle is expected to be high On country roads speed of vehicle is expected to be high On country roads speed of vehicle is expected to be high	C1 - Simply controllable C2 - Normally controllable C1 - Simply controllable C3 - Difficult to control or uncontrollable

<u> </u>	I.	1	<u> </u>	1

		1	

	<u> </u>		

Rationale (for controllability)	Determination of ASIL and ASIL Determination	Safety Goal			
At city speed, most drivers will be able to	QM	Total Loss of Beam Shall			
Rationale (for controllability)	Determination of ASIL and ASIL	Safety Goals Safety Goal			
At city speed, most drivers will be able to	Determination QM QM	Total loss of low beam Total loss of low beam			
On completely unilluminated city roads, When driving on highway with low beam, it Since there is usually no other form of Since there is usually no other form of	A B B	Total loss of low beam Total loss of low beam Total loss of low beam			

		_		

		_		

<u> </u>				
<u> </u>				
<u> </u>				
<u> </u>				
<u> </u>				
<u> </u>				
<u> </u>				
				_
<u></u>			 	

Hazard & Risk Analysis Defin Operational Mode ID Mode OM01 Parked OM02 Ignition on OM03 Normal driving			
ID Mode			
OM03 Normal debits	Remarks Car is parked, ignition is off Car is parked, ignition is on	Reference OM01 - Parked OM02 - Ignition on OM02 - Ignition on	
OM04 Backward driving	Car is driving Car is driving	OM02 - Ignition on OM03 - Normal driving OM04 - Backward driving	
OM05 Degraded driving OM06 Towing (active)	Limp home mode Towing another car	OM05 - Degraded driving OM06 - Towing (active)	
OM07 Towing (passive) OM08 Service OM09 N/A	Beeing towed by another car Vehicle is in repair garage not applicable or not relevant	OM07 - Towing (passive) ————————————————————————————————————	
perational Scenario ID Scenario OS01 Any Road OS02 City Road	Remarks	Reference OS01 - Any Road	
OS03 Country Road	road type road type road type	OS02 - City Road OS03 - Country Road OS03 - Country Road	
OS04 Highway OS05 Mountain Pass	road type road type	OS04 - Highway OS05 - Mountain Pass	
OS06 Off Road OS07 Road with gradient OS08 Road with bump	road type road attribute	OS06 - Off Road OS07 - Road with gradient OS08 - Road with hump	
OS08 Road with bump OS09 Road tunnel OS10 Road with construction site	road attribute road attribute road attribute	OS08 - Road with bump OS09 - Road tunnel OS10 - Road with construction site	
OS11 N/A	not applicable or not relevant	OS11 - N/A	
ituation Details ID Scenario	Remarks	Reference Reference	
SD01 Low speed SD02 High speed SD03 Normal acceleration	driving attribute driving attribute	SD01 - Low speed SD02 - High speed	
SD03 Normal acceleration SD04 High acceleration	driving attribute driving attribute	SD03 - Normal acceleration SD04 - High acceleration SD05 - Normal backing	
SD04 High acceleration SD05 Normal braking SD06 High braking SD07 N/A	driving attribute driving attribute not applicable or not relevant	SD05 - Normal braking	
em Usage ID Mode IU01 Correctly used	Remarks Intended usage	Reference IU01 - Correctly used	
ID Mode IU01 Correctly used IU02 Incorrectly used IU03 N/A	Unintended usage (foreseeable) not applicable or not relevant	IU02 - Incorrectly used IU03 - N/A	
Invironmental Details ID Scenario EN01 Normal conditions	Remarks weather attribute	Reference EN01 - Normal conditions	
EN02 Sun blares (degraded view) EN03 Fog (degraded view) EN04 Snowfall (degraded view)	weather attribute weather attribute	EN02 - Sun blares (degraded view) EN03 - Fog (degraded view) EN04 - Snowfall (degraded view)	
EN05 Cross-wind (lateral force)	weather attribute weather attribute road attribute	EN04 - Snowfall (degraded view) EN05 - Cross-wind (lateral force) EN06 - Rain (slippery road)	
EN06 Rain (slippery road) EN07 Snow (slippery road) EN08 Glace (slippery road)	road attribute road attribute	EN07 - Snow (slippery road) EN08 - Glace (slippery road)	
EN09 N/A	not applicable or not relevant	EN09 - N/A	

		I	

		1	

1	I.	

	Deviation (Guideword)	Remarks	Reference			
DV01 DV02	Function not activated Function unexpectedly activated	Activation error Activation error	DV01 - Function not activated DV02 - Function unexpectedly activated			
DV03 DV04	Function always activated Actor effect is too much	Activation error Quantitative error	DV03 - Function always activated DV04 - Actor effect is too much			
DV05	Actor effect is too less Actor action too early	Quantitative error Timing error	DV05 - Actor effect is too less DV06 - Actor action too early			
DV07	Actor action too late Actor action before	Timing error Sequence error	DV07 - Actor action too late DV08 - Actor action before			
DV09	Actor action after Actor effect is reverse	Sequence error Logical error	DV09 - Actor action after DV10 - Actor effect is reverse			
	Actor effect is reverse Actor effect is wrong Sensor sensitivity is too high	Logical error Quantitative error	DV10 - Actor effect is reverse DV11 - Actor effect is wrong DV12 - Sensor sensitivity is too high			
DV13	Sensor sensitivity is too low	Quantitative error	DV13 - Sensor sensitivity is too low			
DV14 DV15	Sensor detection too early Sensor detection too late	Timing error Timing error	DV14 - Sensor detection too early DV15 - Sensor detection too late			
DV16 DV17	Sensor detection before Sensor detection after	Sequence error Sequence error	DV16 - Sensor detection before DV17 - Sensor detection after			
DV18 DV19	Sensor detection is reverse Sensor detection is wrong	Logical error Logical error	DV18 - Sensor detection is reverse DV19 - Sensor detection is wrong			
DV20	N/A	not applicable or not relevant	DV20 - N/A			
Hazardous Event	s (possibe effects)					
	Hazardous Event None	Remarks	Reference EV-07 - None			
EV-06 EV-05	Front collision with oncoming traffic Front collision with ahead traffic		EV-06 - Front collision with oncoming traffic EV-05 - Front collision with ahead traffic			
EV-04	Front collision with obstacle Rear collision with trailing traffic		EV-04 - Front collision with obstacle EV-03 - Rear collision with trailing traffic			
EV-02	Side collision with other traffic Side collision with obstacle		EV-02 - Side collision with other traffic EV-01 - Side collision with obstacle			
EV00	Collision with other vehicle		EV00 - Collision with other vehicle			
EV01 EV02	Collision with train Collision with pedestrian		EV01 - Collision with train EV02 - Collision with pedestrian			
EV03 EV04	Car spins out of control Car comes off the road		EV03 - Car spins out of control EV04 - Car comes off the road			
EV05 EV06	Car catches file N/A		EV05 - Car catches file EV06 - N/A			

							1
							1
							-
		<u> </u>					
							<u> </u>
							-
							1
							1
			İ		İ		

			I		
	 _	_	 _		

ı					

sure							
ID	Description	Duration (of situation)	Frequency (of situation)	Reference			
E0	Incredible			E0 - Incredible			
E1	Very low probability	Not specified	Occurs less often than once a year for the great majority of drivers	E1 - Very low probability			
E2	Low probability	<1 % of average operating time	Occurs a few times a year for the great majority of drivers	E2 - Low probability			
E3	Medium probability	1 % to 10 % of average operating time	Occurs once a month or more often for an average driver	E3 - Medium probability			
E4	High probability	>10 % of average operating time	Occurs during almost every drive on average	E4 - High probability			
erity							
ID	Description	Remarks	Probability of Injuries	Reference			
S0	No injuries	No injuries	AIS 0 and less than 10 % probability of AIS 1-6	S0 - No injuries			
S1	Light and moderate injuries	Light and moderate injuries	More than 10 % probability of AIS 1-6 (and not S2 or S3)	S1 - Light and moderate injuries			
S2	Severe and life-threatening injuries	Severe and life-threatening injuries (survival probable)	More than 10 % probability of AIS 3-6 (and not S3)	S2 - Severe and life-threatening injuries			
S3	Life-threatening or fatal injuries	Life-threatening injuries (survival uncertain), fatal injuries	More than 10 % probability of AIS 5-6	S3 - Life-threatening or fatal injuries			
	-						
trollability							
ID	Description	Remarks		Reference			
C0	Controllable in general	Controllable in general		C0 - Controllable in general			
C1	Simply controllable	99 % or more of all drivers or other traffic participants are usual	ly able to avoid harm	C1 - Simply controllable			
C2	Normally controllable	90 % or more of all drivers or other traffic participants are usual		C2 - Normally controllable			
C3	Difficult to control or uncontrollable	Less than 90 % of all drivers or other traffic participants are usu		C3 - Difficult to control or uncontrollable			

ľ							
ľ							
Ì							
Ì							
Ì							
ı							
ı							
ı							
ŀ							
ŀ							
ŀ							
ŀ							
ŀ							
ŀ							
ŀ							
ŀ							
ŀ							
ŀ							
ŀ							
ŀ							
ŀ							
- 1		l .			l .		(

Controllability	Exposure		Sev	erity	
Controllability	Lxposure	S0	S1	S2	S3
	E1	QM	QM	QM	QM
C1	E2	QM	QM	QM	QM
C1	E3	QM	QM	QM	Α
	E4	QM	QM	Α	В
	E1	QM	QM	QM	QM
C2	E2	QM	QM	QM	Α
62	E3	QM	QM	Α	В
	E4	QM	Α	В	С
	E1	QM	QM	QM	Α
C3	E2	QM	QM	Α	В
<u> </u>	E3	QM	Α	В	С
	E4	QM	В	С	D