	INSTRUCTIONS:																				
	Fill out the hazard	analysis and risk assessment	elow.																		
	HA-001 should be f	or the lane departure warning	unction as discussed in	the lecture.																	
	HA-002 should be f	or the lane keeping assistance	function as discussed in	the lecture.																	
				e system. Fill in the HA-003 and HA-004	rows.																
	When finished, exp	ort your spreadsheet as a pdf	ile so that a reviewer car	n easily see your work.																	
Hamand ID	Oituational Amakusi						I						101 101								
Hazard ID	Situational Analysi	s T	i=		1, 1,		Hazard Identification		i	1= .5.0		Hazardous Eve	ent Classification					Determination	n of ASIL and Safety Goals		
	Operational Mode	Operational Scenario	Environmental	Situation Details Other Details (optional)	Item Usage	Situation Description	Function Deviation	Deviation Details	(resulting effect)	Event Details	Hazardous Event Description	(of situation)	Rationale   S	Severity (of notential harm)	(for severity)	(of hazardous event)	Rationale  (for controllability)	ASIL   Determination	Safety Goal		
HA-001	OM03 - Normal Drivi	ng OS04 - Highway	EN06 - Rain (slippery ro	SD02 - High speed	IU01 - Correctly used	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			High haptic feedback can affect driver's ability to steer as intented. The driver loose control and could collide with another vehicle or side of the road.		E3 - Medium probability	Driving on a highway with rain could happen between 1% and 10% of the time operating the vehicle.	S3 - Life-threatening or fatal injuries	Collitions at high speed could cause fatal injuries.	C3 - Difficult to control or uncontrollable	It is difficult to stay calm and react properly when the steering well is moving too much.	C	The oscillating steering torque from the Lane Departure Warning function shall be limited.		HA-001
HA-002	OM03 - Normal Drivi	ng OS03 - Country Road	EN01 - Normal conditions	SD02 - High speed	IU02 - Incorrectly used	Normal driving on a country road during normal conditions with high speed and incorrectly used systam.		Lane Keeping function is always activated	s EV00 - Collition with other vehicle.	Driver use the function as if the car was a self-driving car and loose driving attention.	The driver do not use the function properly.	E2 - Low probability	The conviation beween driving at a country road and misusing system should not happen oftern. Less than 1% of the time operating the vehicle.	S3 - Life-threatening or fatal injuries	Collitions at high speed could cause fatal injuries.	C3 - Difficult to control or uncontrollable	When the driver loose focus on driving, it is difficult to re-focus in the case of inmminent collition.	В	The Lane Keeping Assistance function shall be time limited, and additional steering torque shall end after a given time interval so the driver cannot misuse the system for autonomous driving.		HA-002
HA-004	OM03 - Normal Drivi	ng OS03 - Country Road	EN01 - Normal conditions	SD02 - High speed	IU01 - Correctly used	Normal driving on a country road 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		other vehicle.	The Lane Keeping Assistance continue to be activated starting executing random torque to the vehicle making the driver to loose control with potential collition with other vehicle.	The Lane Keeping Assistance start acting randomly when the camera sensor is not working.	E3 - Medium probability	Driving on a highway with rain could happen between 1% and 10% of the time operating the vehicle.	S3 - Life-threatening or fatal injuries	Collitions at high speed could cause fatal injuries.	C3 - Difficult to control or uncontrollable	When the driver loose control of the vechicle is very difficult to realize the situation and act accordently.	С	The Lane Keeping Assistance function shall be deactivated when the camera sensor stop working.		HA-004
HA-004	OM03 - Normal drivi	ng OS02 - City Road	EN04 - Snowfall (degraded view)	SD01 - Low speed	IU01 - Correctly used	Ishowian conditions, thus it is expected that	steering torque when detection	The camera sensors wh determine whether the vehicle is maintaining the lane malfunction and active even when the car is wit the designated lane.	e EV00 - Collision with tivate other vehicle		There is an unexptected torque on the steering, which will drive the vehicle out of its lane.	E2 - Low probability	Depending on the location, driving on a city road during snowfall would be an uncommon occurrence.	S1 - Light and moderate njuries	Since the drive speed is low and is on a city road, the injuries would not be severe.	C2 - Normally controllable	The LKA does not apply sharp turns, this should aler the driver and allow him to rectify the LKA's steering and switch off the Lane Assistance System after identifying the malfunction.	t QM	The LKA shall accurately determine the vehicle's position in the lane and apply steering torque only when required.		HA-004

EXAMPLE DISCUSSED IN THE PROJECT INSTRUCTIONS - Headlamp System  Hazard ID	Site	tuational Analysis	Hazard Identification			Hazardou	s Event Classification		Determination of ASIL and	d Safety Goals	
MORE EXAMPLES - Headlamp System  Hazard ID	Environmental Details  Normal Conditions  Sir	Situation Details (optional) (optional)  Low Speed Night time + Obstacle on the ituation Analysis		ent Details  Hazardous Event Description  Crashes into the  Total loss of low beam	Exposure (of situation) E4 - High probability	Rationale (for exposure) (of potential harm)  night driving in the city is a regular S1 - Light and moderate injuries  Hazardou	Rationale (for severity)  In city traffiic, speed of vehicle is expected to be low  Sevent Classification	Controllability (of hazardous event)  C0 - Controllable in general	Rationale (for controllability) Determination  At city speed, most drivers will be able to QM	Safety Goal  Total Loss of Beam Shall	
Hazard ID           Operational Mode         Operational Scenario           HA-001         OM03 - Normal Driving         OS01 - City Road           HA-002         OM03 - Normal Driving         OS01 - City Road           HA-003         OM03 - Normal Driving         OS03 - Highway           HA-004         OM03 - Normal Driving         OS02 - Country Road           HA-005         OM03 - Normal Driving         OS02 - Country Road	Environmental Details  EN01 - Normal conditions  EN04 - Snowfall (degraded view)  EN04 - Snowfall (degraded view)  EN01 - Normal conditions  EN04 - Snowfall (degraded view)	Situation Details Other Details (optional)	IU01 - Correctly used   Normal Driving on City Road during Normal   Low beam illuminates the   DV01 - Function not activated   Both headlights stop working   EV04 - Front collision with obstacle   Vehicl	ent Details  Crashes into the Crashes in	Exposure (of situation)  E4 - High probability  E1 - Very low probability  E2 - Low probability  E4 - High probability  E2 - Low probability	Rationale (for exposure) (of potential harm)  night driving in the city is a regular S1 - Light and moderate injuries  night driving in the city on S1 - Light and moderate injuries  High driving is part of regular S3 - Life-threatening or fatal injuries  country driving is part of regular S3 - Life-threatening or fatal injuries  country driving is part of regular S3 - Life-threatening or fatal injuries  S3 - Life-threatening or fatal injuries	Rationale (for severity)  In city traffiic, speed of vehicle is expected to be low 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	Controllability (of hazardous event)  C0 - Controllable in general  C1 - Simply controllable  C2 - Normally controllable  C1 - Simply controllable  C3 - Difficult to control or uncontrollable	Rationale (for controllability)  At city speed, most drivers will be able to 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 B Since there is usually no other form of B	Safety Goals  Total loss of low beam	
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Hazard & Risk Analysis	s Definitions		
Operational Mode  ID Mode OM01 Parked OM02 Ignition on OM03 Normal driving		Reference OM01 - Parked OM02 - Ignition on OM03 - Normal driving	
OM04 Backward driving OM05 Degraded driving OM06 Towing (active) OM07 Towing (passive) OM08 Service OM09 N/A	Car is driving Car is driving Limp home mode Towing another car Beeing towed by another car Vehicle is in repair garage not applicable or not relevant	OM03 - Normal driving OM04 - Backward driving OM05 - Degraded driving OM06 - Towing (active) OM07 - Towing (passive) OM08 - Service OM09 - N/A	
Operational Scenario  ID Scenario  OS01 Any Road  OS02 City Road  OS03 Country Road		Reference OS01 - Any Road OS02 - City Road OS03 - Country Road	
OS03   Country Road OS04   Highway OS05   Mountain Pass OS06   Off Road OS07   Road with gradient OS08   Road with bump	road type road type road type road type road attribute road attribute road attribute	OS03 - Country Road OS04 - Highway OS05 - Mountain Pass OS06 - Off Road OS07 - Road with gradient OS08 - Road with bump OS09 - Road tunnel	
OS10 Road tunnel OS10 Road with construction sit OS11 N/A  Situation Details	e road attribute not applicable or not relevant  Remarks	OS09 - Road tunnel OS10 - Road with construction site OS11 - N/A  Reference	
Situation Details  ID Scenario  SD01 Low speed  SD02 High speed  SD03 Normal acceleration  SD04 High acceleration  SD05 Normal braking  SD06 High braking	Remarks driving attribute	Reference  SD01 - Low speed  SD02 - High speed  SD03 - Normal acceleration  SD04 - High acceleration  SD05 - Normal braking  SD06 - High braking	
Item Usage  ID Mode  IU01 Correctly used  IU02 Incorrectly used	Remarks Intended usage Unintended usage (foreseeable) not applicable or not relevant	Reference IU01 - Correctly used	
IU02 Incorrectly used IU03 N/A  Environmental Details ID Scenario		IU02 - Incorrectly used IU03 - N/A  Reference EN01 - Normal conditions	
EN01 Normal conditions EN02 Sun blares (degraded view) EN03 Fog (degraded view) EN04 Snowfall (degraded view) EN05 Cross-wind (lateral force) EN06 Rain (slippery road) EN07 Snow (slippery road) EN08 Glace (slippery road)	weather attribute  v) weather attribute  weather attribute  weather attribute  weather attribute  road attribute	EN01 - Normal conditions  EN02 - Sun blares (degraded view)  EN03 - Fog (degraded view)  EN04 - Snowfall (degraded view)  EN05 - Cross-wind (lateral force)  EN06 - Rain (slippery road)  EN07 - Snow (slippery road)  EN08 - Glace (slippery road)	
EN07 Snow (slippery road) EN08 Glace (slippery road) EN09 N/A	road attribute road attribute not applicable or not relevant	EN07 - Snow (slippery road) EN08 - Glace (slippery road) EN09 - N/A	

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Deviation  ID Deviation (Guideword)  DV01 Function not activated  DV02 Function unexpectedly activated  DV03 Function always activated  DV04 Actor effect is too much  DV05 Actor effect is too less	Remarks Activation error Activation error Activation error	Reference  DV01 - Function not activated  DV02 - Function unexpectedly activated  DV03 - Function always activated					
DV04 Actor effect is too much  DV05 Actor effect is too less  DV06 Actor action too early  DV07 Actor action too late  DV08 Actor action before	Quantitative error Quantitative error Timing error Timing error	DV04 - Actor effect is too much DV05 - Actor effect is too less DV06 - Actor action too early DV07 - Actor action too late					
DV09 Actor action after  DV10 Actor effect is reverse  DV11 Actor effect is wrong	Sequence error Sequence error Logical error Logical error	DV08 - Actor action before  DV09 - Actor action after  DV10 - Actor effect is reverse  DV11 - Actor effect is wrong					
DV12 Sensor sensitivity is too high  DV13 Sensor sensitivity is too low  DV14 Sensor detection too early  DV15 Sensor detection too late  DV16 Sensor detection before	Quantitative error Quantitative error Timing error Timing error Sequence error	DV12 - Sensor sensitivity is too high  DV13 - Sensor sensitivity is too low  DV14 - Sensor detection too early  DV15 - Sensor detection too late  DV16 - Sensor detection before					
DV17 Sensor detection after  DV18 Sensor detection is reverse  DV19 Sensor detection is wrong  DV20 N/A	Sequence error Sequence error Logical error Logical error not applicable or not relevant	DV17 - Sensor detection after  DV18 - Sensor detection is reverse  DV19 - Sensor detection is wrong  DV20 - N/A					
Hazardous Events (possibe effects)  ID Hazardous Event		Reference					
EV-07 None  EV-06 Front collision with oncoming traffic  EV-05 Front collision with ahead traffic  EV-04 Front collision with obstacle		EV-07 - None  EV-06 - Front collision with oncoming traffic  EV-05 - Front collision with ahead traffic  EV-04 - Front collision with obstacle					
EV-04 Front collision with ahead traffic  EV-04 Front collision with obstacle  EV-03 Rear collision with trailing traffic  EV-02 Side collision with other traffic  EV-01 Side collision with obstacle  EV-00 Collision with other vehicle  EV01 Collision with train  EV02 Collision with pedestrian  EV03 Car spins out of control  EV04 Car comes off the road  EV05 Car catches file  EV06 N/A		EV-03 - Rear collision with trailing traffic  EV-02 - Side collision with other traffic  EV-01 - Side collision with obstacle  EV00 - Collision with other vehicle  EV01 - Collision with train					
EV02 Collision with pedestrian EV03 Car spins out of control EV04 Car comes off the road EV05 Car catches file		EV02 - Collision with pedestrian EV03 - Car spins out of control EV04 - Car comes off the road EV05 - Car catches file					
EV06 N/A		EV06 - N/A					

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Exposure												
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									
E3	Low probability  Medium probability	1 % to 10 % of average operating time	Occurs once a month or more often for an average driver	E2 - Low probability E3 - Medium probability								
E4	High probability	>10 % of average operating time	Occurs during almost every drive on average	E4 - High probability								
Severity												
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								
Controllability												
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 usually a	able to avoid harm	C1 - Simply controllable								
C2	Normally controllable	90 % or more of all drivers or other traffic participants are usually a Less than 90 % of all drivers or other traffic participants are usually	able to avoid harm	C2 - Normally controllable								
C3	Difficult to control or uncontrollable	Less than 90 % of all drivers or other traffic participants are usually	y able, or barely able, to avoid harm	C3 - Difficult to control or uncontrollable								

Controllability	Exposure	Severity										
Controllability	Lxposure	S0	S1	S2	S3							
	E1	QM	QM	QM	QM							
C1	E2	QM	QM	QM	QM							
	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							
Ca	E2	QM	QM	Α	В							
C3	E3	QM	Α	В	С							
	E4	QM	В	С	D							