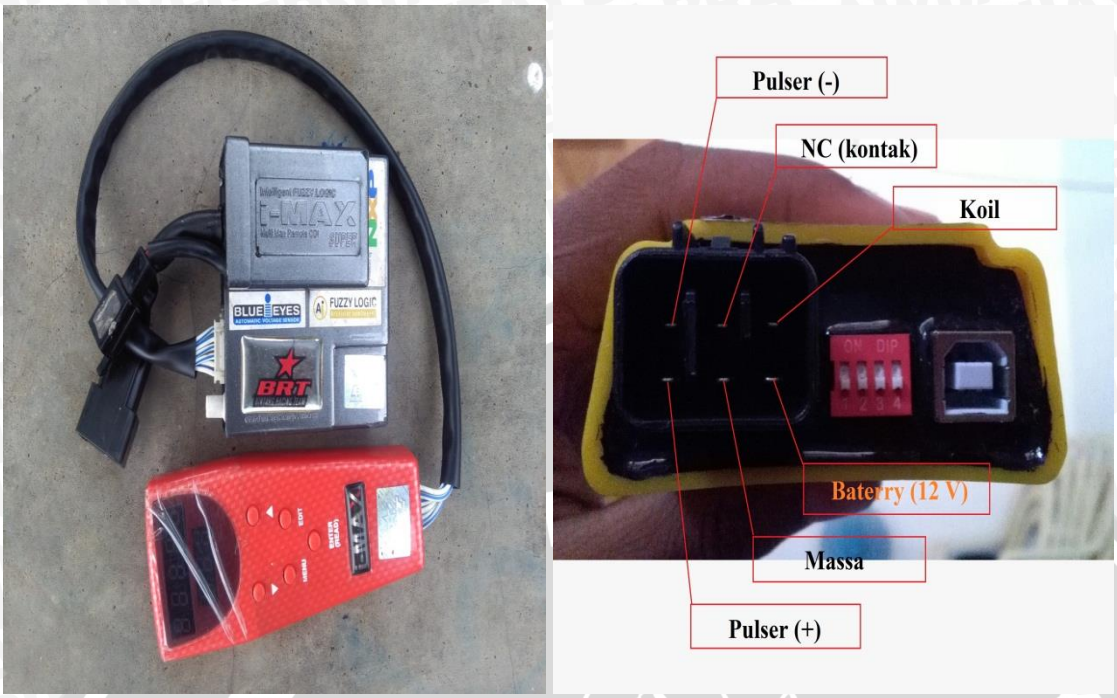
Lampiran 1. Kegiatan penelitian

Lampiran 2. CDI *Programmable*



Lampiran 3. Pemrograman CDI

Lampiran 4. Maping pengapian dalam penelitian

Maping derajat pengapian yang dipakai dalam penelitian inii adalah maping derajat pengapian standart HONDA KARISMA.

putaran	Derajat pengapian standar	Dipercepat 2^o	Dipercepat 4^o	Diperlambat 2^o	Diperlambat 4^o
3000	26.84	28.84	30.84	24.84	22.84
3500	28.97	30.97	32.97	26.97	24.97
4000	31.26	33.26	35.26	29.26	27.26
4500	32.41	34.41	36.41	30.41	28.41
5000	33.88	35.88	37.88	31.88	29.88
5500	34.54	36.54	38.54	32.54	30.54
6000	35.36	37.36	39.36	33.36	31.36
6500	35.85	37.85	39.85	33.85	31.85

rpm	rps	1 put (dtk)	dtk/drjt	Delay (dtk)
3000	50	0.02	5.55556E-05	0.001491
3500	58.33333	0.0171429	4.7619E-05	0.00138
4000	66.66667	0.015	4.16667E-05	0.001303
4500	75	0.0133333	3.7037E-05	0.0012
5000	83.33333	0.012	3.33333E-05	0.001129
5500	91.66667	0.0109091	3.0303E-05	0.001047
6000	100	0.01	2.77778E-05	0.000982
6500	108.3333	0.0092308	2.5641E-05	0.000919

Lampiran 5. Sifat-sifat bahan bakar yang digunakan dalam pengujian.

Sifat	**Unit**	**Besaran**
Density	Kg/m^3	740
Lower Heating Value	Kkal/kg	10575
Titik Didih Penguapan	^oC	205
Research Oktan Number	-	92

Lampiran 6. Data hasil pengujian motor bakar 6 langkahvariasi 1

GIGI 1		Variasi 1 (pengapian standart)												
		F (Kg)							t (s)			Emisi gas buang			
No	n	F_{max}^1	F_{max}^2	F_{max} Av	F_{min}^1	F_{min}^2	F_{min} Av	F	t^1	t^2	t Av	Co	O2	Co2	HC
	rpm	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(s)	(s)	(s)	%vol	%vol	%vol	ppm-vol
1	3000	74	73	73.5	41	43	42	57.75	4.50	5.56	5.03	7.156	7.08	10.87	187
2	3500	70	70	70	37	40	38.5	54.25	2.84	1.94	2.39	7.513	0.27	9.5	196
3	4000	65	63	64	30	37	33.5	48.75	3.37	1.55	2.46	7.465	0.93	8.88	172
4	4500	60	60	60	20	35	27.5	43.75	1.75	1.15	1.45	6.222	0.26	10.12	174
5	5000	50	50	50	25	33	29	39.5	2.81	2.07	2.44	4.293	0.46	11.23	159
6	5500	35	33	34	15	20	17.5	25.75	1.75	2.13	1.94	2.068	0.48	12.59	146
7	6000	30	24	27	13	10	11.5	19.25	2.46	2.43	2.445	0.277	1.97	12.68	387
8	6500	8	5	6.5	2	2	2	4.25	3.53	3.87	3.7	0.115	2.52	12.45	231
GIGI 2		Variasi 1 (pengapian standart)												
		F (Kg)							t (s)			Emisi gas buang			
No	n	F_{max}^1	F_{max}^2	F_{max} Av	F_{min}^1	F_{min}^2	F_{min} Av	F	t^1	t^2	t Av	Co	O2	Co2	HC
	rpm	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(s)	(s)	(s)	%vol	%vol	%vol	ppm-vol
1	3000	55	75	65	33	42	37.5	51.25	2.25	4.75	3.5	8.084	7.22	8.68	238
2	3500	60	64	62	35	40	37.5	49.75	2.29	2.23	2.26	8.223	0.47	8.55	236
3	4000	55	55	55	20	35	27.5	41.25	3.4	2.65	3.025	6.705	0.51	9.16	209
4	4500	47	48	47.5	25	23	24	35.75	3.05	2.3	2.675	5.737	10.43	10.23	219
5	5000	35	42	38.5	22	20	21	29.75	3.22	2.52	2.87	5.491	0.41	10.33	217
6	5500	25	38	31.5	10	15	12.5	22	1.87	1.61	1.74	1.795	1.39	11.94	239
7	6000	7	25	16	3	11	7	11.5	3.03	2.19	2.61	0.174	2.57	12.35	464
8	6500	5	4	4.5	2	2	2	3.25	4.99	8.25	6.62	0.18	4.93	10.43	1323

Lampiran 7. Data hasil pengujian motor bakar 6 langkah variasi 2

GIGI 1		Variasi 2 (pengapian maju 2°)													
		F (Kg)							t (s)			Emisi gas buang			
No	n	F_{max}^1	F_{max}^2	F_{max} Av	F_{min}^1	F_{min}^2	F_{min} Av	F	t^1	t^2	t Av	Co	O2	Co2	HC
	rpm	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(s)	(s)	(s)	%vol	%vol	%vol	ppm-vol
1	3000	70	65	67.5	45	30	37.5	52.5	3.15	6.29	4.72	0.033	8.86	11.6	131
2	3500	65	75	70	40	40	40	55	4.15	3.98	4.065	0.037	3.76	11.3	121
3	4000	60	65	62.5	45	30	37.5	50	2.45	3.11	2.78	0.39	4.54	11.1	148
4	4500	48	60	54	30	35	32.5	43.25	1.59	3.37	2.48	4.45	2.69	9.9	152
5	5000	45	45	45	25	20	22.5	33.75	3.08	2.33	2.705	2.897	1.55	2.89	146
6	5500	33	35	34	15	15	15	24.5	1.59	1.56	1.575	0.07	2.53	12.8	116
7	6000	12	6	9	3	2	2.5	5.75	1.98	2.9	2.44	0.092	3.78	11.8	304
8	6500	1	6	3.5	1	0	0.5	2	3.21	5.19	4.2	0.148	4.2	11.7	347
GIGI 2		Variasi 2 (pengapian maju 2°)													
		F (Kg)							t (s)			Emisi gas buang			
No	n	F_{max}^1	F_{max}^2	F_{max} Av	F_{min}^1	F_{min}^2	F_{min} Av	F	t^1	t^2	t Av	Co	O2	Co2	HC
	rpm	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(s)	(s)	(s)	%vol	%vol	%vol	ppm-vol
1	3000	65	70	67.5	48	40	44	55.75	4.13	3.27	3.7	8.272	1.24	8.62	228
2	3500	60	60	60	35	35	35	47.5	3.97	3.59	3.78	7.162	0.63	9.63	190
3	4000	55	60	57.5	30	37	33.5	45.5	3.07	1.65	2.36	6.424	0.89	9.75	195
4	4500	50	55	52.5	25	30	27.5	40	2.92	3.09	3.005	3.694	0.82	11.4	174
5	5000	48	49	48.5	20	30	25	36.75	3.01	2.79	2.9	4.581	0.89	11.1	169
6	5500	18	25	21.5	10	10	10	15.75	1.96	1.64	1.8	1/519	1.19	12.4	135
7	6000	7	20	13.5	2	10	6	9.75	2.72	2.98	2.85	0.106	2.04	13	124
8	6500	2	5	3.5	1	1	1	2.25	2.38	3.08	2.73	0.077	3.43	11,87	282

Lampiran 8. Data hasil pengujian motor bakar 6 langkah variasi 3

GIGI 1		Variasi 3 (pengapian maju 4°)													
		F (Kg)							t (s)			Emisi gas buang			
No	n	F_{max}^1	F_{max}^2	F_{max} Av	F_{min}^1	F_{min}^2	F_{min} Av	F	t^1	t^2	t Av	Co	O2	Co2	HC
	rpm	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(s)	(s)	(s)	%vol	%vol	%vol	ppm-vol
1	3000	65	72	68.5	40	40	40	54.25	5.78	5.22	5.5	5.888	1.19	10.87	152
2	3500	75	65	70	35	35	35	52.5	4.51	4.78	4.645	2.4	0.36	12.24	162
3	4000	57	60	58.5	30	30	30	44.25	4.27	6.36	5.315	5.218	1.32	10.26	160
4	4500	53	60	56.5	30	35	32.5	44.5	1.88	3.04	2.46	6.179	1.31	9.9	175
5	5000	45	70	57.5	20	23	21.5	39.5	2.69	3.14	2.915	5.156	1.14	10.78	140
6	5500	35	60	47.5	15	20	17.5	32.5	1.76	3.08	2.42	2.069	0.95	12.83	124
7	6000	15	30	22.5	3	15	9	15.75	2.35	4.16	3.255	0.098	1.99	13.1	73
8	6500	10	15	12.5	2	3	2.5	7.5	4.29	4.2	4.245	0.085	3.67	11.92	77
GIGI 2		Variasi 3 (pengapian maju 4°)													
		F (Kg)							t (s)			Emisi gas buang			
No	n	F_{max}^1	F_{max}^2	F_{max} Av	F_{min}^1	F_{min}^2	F_{min} Av	F	t^1	t^2	t Av	Co	O2	Co2	HC
	rpm	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(s)	(s)	(s)	%vol	%vol	%vol	ppm-vol
1	3000	60	65	62.5	20	35	27.5	45	5.69	3.4	4.545	6.835	0.35	10.15	223
2	3500	63	60	61.5	33	30	31.5	46.5	3.22	3.2	3.21	6.782	0.49	10.22	194
3	4000	60	40	50	20	15	17.5	33.75	2.97	3.46	3.215	5.019	0.59	11.2	179
4	4500	55	48	51.5	15	20	17.5	34.5	3.04	3.74	3.39	4.238	0.49	11.82	166
5	5000	50	45	47.5	20	25	22.5	35	2.45	3.56	3.005	3.278	2.54	12.37	144
6	5500	19	15	17	10	5	7.5	12.25	2.79	2.65	2.72	2.898	1.26	12.49	157
7	6000	11	7	9	3	3	3	6	3.02	3.05	3.035	0.056	3.76	12.09	78
8	6500	3	5	4	1	2	1.5	2.75	5.73	5.45	5.59	0.068	4.12	11.59	71

Lampiran 9. Data hasil pengujian motor bakar 6 langkah variasi 4

GIGI 1		Variasi 4 (pengapian mundur 2°)													
		F (Kg)							t (s)			Emisi gas buang			
No	n	$F_{max}{}^1$	$F_{max}{}^2$	F_{max} Av	$F_{min}{}^1$	$F_{min}{}^2$	F_{min} Av	F	t^1	t^2	t Av	Co	O2	Co2	HC
	rpm	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(s)	(s)	(s)	%vol	%vol	%vol	ppm-vol
1	3000	73	70	71.5	45	45	45	58.25	3.31	3.50	3.405	7.652	0.21	9.69	181
2	3500	66	66	66	40	20	30	48	3.15	2.50	2.825	7.689	0.41	9.58	173
3	4000	63	60	61.5	26	32	29	45.25	2.15	2.00	2.075	7.551	0.19	9.9	174
4	4500	53	50	51.5	30	25	27.5	39.5	1.99	1.72	1.855	5.376	1.33	10.23	151
5	5000	46	33	39.5	24	13	18.5	29	1.35	1.51	1.43	5.313	0.24	11.09	172
6	5500	35	14	24.5	20	7	13.5	19	1.53	1.60	1.565	4.064	0.16	12.38	162
7	6000	23	7	15	10	5	7.5	11.25	2.48	2.05	2.265	0.712	1.41	13.35	571
8	6500	5	4	4.5	2	2	2	3.25	5.21	2.52	3.865	0.528	1.65	13.41	560
GIGI 2		Variasi 4 (pengapian mundur 2°)													
		F (Kg)							t (s)			Emisi gas buang			
No	n	$F_{max}{}^1$	$F_{max}{}^2$	F_{max} Av	$F_{min}{}^1$	$F_{min}{}^2$	F_{min} Av	F	t^1	t^2	t Av	Co	O2	Co2	HC
	rpm	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(s)	(s)	(s)	%vol	%vol	%vol	ppm-vol
1	3000	60	75	67.5	30	35	32.5	50	2.99	2	2.495	5.362	0.77	10.41	186
2	3500	70	70	70	37	35	36	53	1.91	3.5	2.705	5.88	0.41	10.43	192
3	4000	62	65	63.5	30	20	25	44.25	2.4	1.44	1.92	4.178	0.62	11.09	179
4	4500	55	57	56	27	30	28.5	42.25	2.04	1.54	1.79	5.174	0.68	10.34	136
5	5000	42	40	41	19	21	20	30.5	2.32	2.43	2.375	5.712	0.12	11.05	151
6	5500	31	25	28	15	10	12.5	20.25	1.28	1.57	1.425	4.756	0.12	11.71	139
7	6000	12	12	12	7	4	5.5	8.75	1.91	1.5	1.705	0.784	1.76	12.43	538
8	6500	3	2	2.5	2	1	1.5	2	3.09	4.28	3.685	1.434	0.61	13.17	332

Lampiran 10. Data hasil perhitungan moto rbakar 6 langkah variasi 5

GIGI 1		Variasi 1 Pengapian mundur 4°													
		F (Kg)							t (s)			Emisi gas buang			
NO	n	$F_{max}{}^1$	$F_{max}{}^2$	F_{max} Av	$F_{min}{}^1$	$F_{min}{}^2$	F_{min} Av	F	t^1	t^2	t Av	Co	O2	Co2	HC
	rpm	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(s)	(s)	(s)	%vol	%vol	%vol	ppm-vol
1	3000	65	68	66.5	43	50	46.5	56.5	2.74	2,70	2.74	0.983	10.99	6.05	129
2	3500	45	53	49	35	20	27.5	38.25	5.76	2.9	4.33	1.694	11.3	7.16	134
3	4000	43	30	36.5	30	15	22.5	29.5	2.8	2.38	2.59	2.16	8.59	6.34	131
4	4500	40	35	37.5	20	20	20	28.75	1.64	1.45	1.545	4.09	5.78	7.85	160
5	5000	40	43	41.5	25	25	25	33.25	1.6	1.8	1.7	4.72	5.92	6.7	163
6	5500	37	25	31	21	10	15.5	23.25	1.78	1.59	1.685	5.12	4.97	7.72	165
7	6000	30	7	18.5	15	2	8.5	13.5	1.89	2.44	2.165	0.64	2.62	12	147
8	6500	5	1	3	1	1	1	2	3.34	2.38	2.86	0.17	4	11.5	859
GIGI 2		Variasi 1 Pengapian mundur 4°													
		F (Kg)							t (s)			Emisi gas buang			
NO	n	$F_{max}{}^1$	$F_{max}{}^2$	F_{max} Av	$F_{min}{}^1$	$F_{min}{}^2$	F_{min} Av	F	t^1	t^2	t Av	Co	O2	Co2	HC
	rpm	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(kg)	(s)	(s)	(s)	%vol	%vol	%vol	ppm-vol
1	3000	43	60	51.5	30	35	32.5	42	2.93	2.89	2.91	7.51	9.63	6.85	224
2	3500	50	65	57.5	35	20	27.5	42.5	2.78	2.57	2.675	7.52	3.73	6.99	227
3	4000	40	47	43.5	23	30	26.5	35	1.61	1.71	1.66	5.84	6.16	6.21	231
4	4500	35	40	37.5	20	15	17.5	27.5	1.86	2.09	1.975	3.92	6.88	6.61	211
5	5000	30	37	33.5	15	20	17.5	25.5	1.7	2.01	1.855	5.55	6.6	8.63	271
6	5500	25	35	30	20	5	12.5	21.25	1.36	1.91	1.635	0.447	5.11	10.31	493
7	6000	10	12	11	18	7	12.5	11.75	2.08	2.99	2.535	0.302	5.04	10.39	1055
8	6500	3	1	2	0	0	0	1	2.13	3.08	2.605	0.21	2.92	12.31	485

Lampiran 11. Data hasil perhitungan motor bakar 6 langkah variasi 1

Variasi 1 (pengapian standart)												
GIGI	n	Td	Tc	P	Fc	SFc	ηe	Co	O2	Co2	No2	HC
	(rpm)	(kg.m)	(kg.m)	(Hp)	(kg/h)	(kg/hp.h)	(%)	(%vol)	(%vol)	(%vol)	(%vol)	(%vol)
1	3000	15.76	0.57	2.38	0.265	0.111	53.745	7.156	7.08	10.87	74.89	187
	3500	14.88	0.54	2.62	0.557	0.212	28.138	7.513	0.27	9.5	82.72	196
	4000	13.51	0.49	2.72	0.541	0.199	30.042	7.465	0.93	8.88	82.73	172
	4500	12.26	0.44	2.78	0.919	0.331	18.078	6.222	0.26	10.12	83.40	174
	5000	11.20	0.40	2.82	0.546	0.194	30.870	4.293	0.46	11.23	84.02	159
	5500	7.76	0.28	2.15	0.687	0.319	18.709	2.068	0.48	12.59	84.86	146
	6000	6.13	0.22	1.85	0.545	0.294	20.334	0.277	1.97	12.68	85.07	387
	6500	2.38	0.09	0.78	0.360	0.461	12.951	0.115	2.52	12.45	84.92	231
GIGI	n	Td	Tc	P	Fc	SFc	ηe	Co	O2	Co2	No2	HC
	(rpm)	(kg.m)	(kg.m)	(Hp)	(kg/h)	(kg/hp.h)	(%)	(%vol)	(%vol)	(%vol)	(%vol)	(%vol)
2	3000	14.13	0.76	3.17	0.381	0.120	49.809	8.084	7.22	8.68	76.02	238
	3500	13.76	0.74	3.60	0.589	0.164	36.527	8.223	0.47	8.55	82.76	236
	4000	11.63	0.62	3.48	0.440	0.126	47.245	6.705	0.51	9.16	83.63	209
	4500	10.26	0.55	3.45	0.498	0.144	41.445	5.737	10.43	10.23	73.60	219
	5000	8.76	0.47	3.28	0.464	0.142	42.182	5.491	0.41	10.33	83.77	217
	5500	6.82	0.37	2.81	0.766	0.273	21.908	1.795	1.39	11.94	84.88	239
	6000	4.20	0.22	1.88	0.510	0.271	22.051	0.174	2.57	12.35	84.91	464
	6500	2.13	0.11	1.04	0.201	0.194	30.801	0.18	4.93	10.43	84.46	1323

Lampiran 12. Data hasil perhitungan motor bakar 6 langkah variasi 2

Variasi 2 (pengapian maju 2°)												
GIGI	n	Td	Tc	P	Fc	SFc	ηe	Co	O2	Co2	No2	HC
	(rpm)	(kg.m)	(kg.m)	(Hp)	(kg/h)	(kg/hp.h	(%)	(%vol)	(%vol)	(%vol)	(%vol)	(%vol)
1	3000	14.45	0.52	2.18	0.282	0.129	46.232	0.033	8.86	11.59	79.52	131
	3500	15.07	0.54	2.66	0.328	0.123	48.462	0.037	3.76	11.27	84.93	121
	4000	13.82	0.50	2.78	0.479	0.172	34.735	0.39	4.54	11.1	83.97	148
	4500	12.13	0.44	2.75	0.537	0.195	30.604	4.45	2.69	9.9	82.96	152
	5000	9.76	0.35	2.46	0.492	0.200	29.829	2.897	1.55	2.89	92.66	146
	5500	7.45	0.27	2.06	0.846	0.410	14.577	0.07	2.53	12.76	84.64	116
	6000	2.76	0.10	0.83	0.546	0.655	9.125	0.092	3.78	11.75	84.38	304
	6500	1.82	0.07	0.60	0.317	0.532	11.230	0.148	4.2	11.69	83.96	347
GIGI	n	Td	Tc	P	Fc	SFc	ηe	Co	O2	Co2	No2	HC
	(rpm)	(kg.m)	(kg.m)	(Hp)	(kg/h)	(kg/hp.h	(%)	(%vol)	(%vol)	(%vol)	(%vol)	(%vol)
2	3000	15.26	0.82	3.42	0.360	0.105	56.847	8.272	1.24	8.62	81.87	228
	3500	13.20	0.71	3.45	0.352	0.102	58.596	7.162	0.63	9.63	82.58	190
	4000	12.70	0.68	3.80	0.564	0.149	40.226	6.424	0.89	9.75	82.94	195
	4500	11.32	0.61	3.81	0.443	0.116	51.381	3.694	0.82	11.39	84.10	174
	5000	10.51	0.56	3.93	0.459	0.117	51.141	4.581	0.89	11.08	83.45	169
	5500	5.26	0.28	2.16	0.740	0.342	17.471	1/519	1.19	12.41	86.40	135
	6000	3.76	0.20	1.69	0.467	0.277	21.567	0.106	2.04	13.04	84.81	124
	6500	1.88	0.10	0.92	0.488	0.533	11.213	0.077	3.43	11,87	96.49	282

Lampiran 13. Data hasil perhitungan motor bakar 6 langkah variasi 3

Variasi 3 (pengapian maju 4°)												
GIGI	n	Td	Tc	P	Fc	SFc	ηe	Co	O2	Co2	No2	HC
	(rpm)	(kg.m)	(kg.m)	(Hp)	(kg/h)	(kg/hp.h)	(%)	(%vol)	(%vol)	(%vol)	(%vol)	(%vol)
1	3000	14.88	0.54	2.25	0.242	0.108	55.503	5.888	1.19	10.87	82.05	152
	3500	14.45	0.52	2.55	0.287	0.113	53.080	2.4	0.36	12.24	85.00	162
	4000	12.38	0.45	2.50	0.251	0.100	59.502	5.218	1.32	10.26	83.20	160
	4500	12.45	0.45	2.82	0.541	0.192	31.139	6.179	1.31	9.9	82.61	175
	5000	11.20	0.40	2.82	0.457	0.162	36.880	5.156	1.14	10.78	82.92	140
	5500	9.45	0.34	2.62	0.550	0.210	28.414	2.069	0.95	12.83	84.15	124
	6000	5.26	0.19	1.59	0.409	0.258	23.208	0.098	1.99	13.1	84.81	73
	6500	3.20	0.12	1.05	0.314	0.300	19.926	0.085	3.67	11.92	84.33	77
GIGI	n	Td	Tc	P	Fc	SFc	ηe	Co	O2	Co2	No2	HC
	(rpm)	(kg.m)	(kg.m)	(Hp)	(kg/h)	(kg/hp.h)	(%)	(%vol)	(%vol)	(%vol)	(%vol)	(%vol)
2	3000	12.57	0.67	2.82	0.293	0.104	57.529	6.835	0.35	10.15	82.67	223
	3500	12.95	0.69	3.39	0.415	0.122	48.817	6.782	0.49	10.22	82.51	194
	4000	9.76	0.52	2.92	0.414	0.142	42.119	5.019	0.59	11.2	83.19	179
	4500	9.95	0.53	3.35	0.393	0.117	50.923	4.238	0.49	11.82	83.45	166
	5000	10.07	0.54	3.77	0.443	0.118	50.786	3.278	2.54	12.37	81.81	144
	5500	4.38	0.23	1.80	0.490	0.272	22.007	2.898	1.26	12.49	83.35	157
	6000	2.82	0.15	1.27	0.439	0.347	17.237	0.056	3.76	12.09	84.09	78
	6500	2.01	0.11	0.98	0.238	0.244	24.484	0.068	4.12	11.59	84.22	71

Lampiran 14. Data hasil perhitungan motor bakar 6 langkah variasi 4

Variasi 4 (pengapian mundur 2°)												
GIGI	n	Td	Tc	P	Fc	SFc	ηe	Co	O2	Co2	No2	HC
	(rpm)	(kg.m)	(kg.m)	(Hp)	(kg/h)	(kg/hp.h	(%)	(%vol)	(%vol)	(%vol)	(%vol)	(%vol)
1	3000	15.88	0.57	2.40	0.391	0.163	36.670	7.652	0.21	9.69	82.45	181
	3500	13.32	0.48	2.35	0.472	0.201	29.768	7.689	0.41	9.58	82.32	173
	4000	12.63	0.46	2.55	0.642	0.252	23.699	7.551	0.19	9.9	82.36	174
	4500	11.20	0.40	2.54	0.718	0.283	21.122	5.376	1.33	10.23	83.06	151
	5000	8.57	0.31	2.16	0.931	0.432	13.850	5.313	0.24	11.09	83.36	172
	5500	6.07	0.22	1.68	0.851	0.506	11.809	4.064	0.16	12.38	83.40	162
	6000	4.13	0.15	1.25	0.588	0.471	12.694	0.712	1.41	13.35	84.53	571
	6500	2.13	0.08	0.70	0.345	0.494	12.109	0.528	1.65	13.41	84.41	560
GIGI	n	Td	Tc	P	Fc	SFc	ηe	Co	O2	Co2	No2	HC
	(rpm)	(kg.m)	(kg.m)	(Hp)	(kg/h)	(kg/hp.h	(%)	(%vol)	(%vol)	(%vol)	(%vol)	(%vol)
2	3000	13.82	0.74	3.10	0.534	0.172	34.721	5.362	0.77	10.41	83.46	186
	3500	14.57	0.78	3.81	0.492	0.129	46.301	5.88	0.41	10.43	83.28	192
	4000	12.38	0.66	3.71	0.694	0.187	31.920	4.178	0.62	11.09	84.11	179
	4500	11.88	0.64	4.00	0.744	0.186	32.127	5.174	0.68	10.34	83.81	136
	5000	8.95	0.48	3.35	0.561	0.168	35.654	5.712	0.12	11.05	83.12	151
	5500	6.38	0.34	2.63	0.935	0.356	16.791	4.756	0.12	11.71	83.41	139
	6000	3.51	0.19	1.57	0.781	0.496	12.044	0.784	1.76	12.43	85.03	538
	6500	1.82	0.10	0.89	0.361	0.408	14.633	1.434	0.61	13.17	84.79	332

Lampiran 15. Data hasil perhitungan motor bakar 6 langkah variasi 5

Variasi 5 (pengapian mundur 4°)												
GIGI	n	Td	Tc	P	Fc	SFc	ηe	Co	O2	Co2	No2	HC
	(rpm)	(kg.m)	(kg.m)	(Hp)	(kg/h)	(kg/hp.h)	(%)	(%vol)	(%vol)	(%vol)	(%vol)	(%vol)
1	3000	15.45	0.56	2.33	0.486	0.208	28.696	0.983	10.99	6.05	81.98	129
	3500	10.88	0.39	1.92	0.308	0.160	37.277	1.694	11.3	7.16	79.85	134
	4000	8.70	0.31	1.75	0.514	0.294	20.360	2.16	8.59	6.34	82.91	131
	4500	8.51	0.31	1.93	0.862	0.447	13.369	4.09	5.78	7.85	82.28	160
	5000	9.63	0.35	2.43	0.784	0.323	18.506	4.72	5.92	6.7	82.66	163
	5500	7.13	0.26	1.98	0.791	0.400	14.940	5.12	4.97	7.72	82.19	165
	6000	4.70	0.17	1.42	0.615	0.434	13.785	0.64	2.62	12	84.74	147
	6500	1.82	0.07	0.60	0.466	0.781	7.647	0.17	4	11.5	84.33	859
GIGI	n	Td	Tc	P	Fc	SFc	ηe	Co	O2	Co2	No2	HC
	(rpm)	(kg.m)	(kg.m)	(Hp)	(kg/h)	(kg/hp.h)	(%)	(%vol)	(%vol)	(%vol)	(%vol)	(%vol)
2	3000	11.82	0.63	2.65	0.458	0.173	34.636	7.51	9.63	6.85	76.01	224
	3500	11.95	0.64	3.13	0.498	0.159	37.538	7.52	3.73	6.99	81.76	227
	4000	10.07	0.54	3.01	0.802	0.266	22.444	5.84	6.16	6.21	81.79	231
	4500	8.20	0.44	2.76	0.674	0.244	24.447	3.92	6.88	6.61	82.59	211
	5000	7.70	0.41	2.88	0.718	0.249	23.956	5.55	6.6	8.63	79.22	271
	5500	6.63	0.36	2.73	0.815	0.299	20.020	0.447	5.11	10.31	84.13	493
	6000	4.26	0.23	1.91	0.525	0.275	21.736	0.302	5.04	10.39	84.27	1055
	6500	1.57	0.08	0.76	0.511	0.670	8.923	0.21	2.92	12.31	84.56	485

Lampiran 16. Data hasil perhitungan rata-rata motor bakar 6 langkah variasi 1

Variasi 1 (pengapian standart)										
Average										
n	Td	Tc	P	SFC_e	η_e	CO	O_2	CO_2	NO_2	HC
(rpm)	(kg·m)	(kg·m)	(hp)	(kg/hp·h)	%	(%vol)	(%vol)	(%vol)	(%vol)	(ppm-vol)
3000	14.95	0.66	2.381	0.116	51.777	7.62	7.15	9.78	75.46	212.5
3500	14.32	0.64	2.624	0.188	32.333	7.87	0.37	9.03	82.74	216
4000	12.57	0.56	2.722	0.163	38.643	7.09	0.72	9.02	83.18	190.5
4500	11.26	0.50	2.779	0.237	29.761	5.98	5.35	10.18	78.50	196.5
5000	9.98	0.44	2.820	0.168	36.526	4.89	0.44	10.78	83.89	188
5500	7.29	0.32	2.149	0.296	20.308	1.93	0.94	12.27	84.87	192.5
6000	5.16	0.22	1.854	0.282	21.192	0.23	2.27	12.52	84.99	425.5
6500	2.26	0.10	0.780	0.328	21.876	0.15	3.73	11.44	84.69	777

Lampiran 17. Data hasi lperhitungan rata-rata motor bakar 6 langkah variasi 2

Variasi 2 (pengapian maju 2°)										
Average										
n	Td	Tc	P	SFC_e	η_e	CO	O_2	CO_2	NO_2	HC
(rpm)	(kg·m)	(kg·m)	(hp)	(kg/hp·h)	%	(%vol)	(%vol)	(%vol)	(%vol)	(ppm-vol)
3000	14.85	0.67	2.804	0.117	51.539	4.15	5.05	10.11	80.69	179.5
3500	14.13	0.63	3.056	0.113	53.529	3.60	2.20	10.45	83.76	155.5
4000	13.26	0.59	3.292	0.160	37.480	3.41	2.72	10.43	83.45	171.5
4500	11.73	0.52	3.281	0.156	40.992	4.07	1.76	10.65	83.53	163
5000	10.13	0.46	3.194	0.159	40.485	3.74	1.22	6.99	88.06	157.5
5500	6.35	0.28	2.113	0.376	16.024	0.07	1.86	12.59	85.52	125.5
6000	3.26	0.15	1.260	0.466	15.346	0.10	2.91	12.40	84.60	214
6500	1.85	0.08	0.756	0.533	11.221	0.11	3.82	11.69	90.23	314.5

Lampiran 18. Data hasi lperhitungan rata-rata motor bakar 6 langkah variasi 3

Variasi 3										
Average										
n	Td	Tc	P	SFC_e	η_e	CO	O_2	CO_2	NO_2	HC
(rpm)	(kg·m)	(kg·m)	(hp)	(kg/hp·h)	%	(%vol)	(%vol)	(%vol)	(%vol)	(ppm-vol)
3000	13.73	0.61	2.535	0.106	56.516	6.36	0.77	10.51	82.36	187.5
3500	13.70	0.61	2.968	0.118	50.949	4.59	0.43	11.23	83.75	178
4000	11.07	0.48	2.708	0.121	50.810	5.12	0.96	10.73	83.20	169.5
4500	11.20	0.49	3.085	0.155	41.031	5.21	0.90	10.86	83.03	170.5
5000	10.63	0.47	3.293	0.140	43.833	4.22	1.84	11.58	82.37	142
5500	6.91	0.29	2.210	0.241	25.210	2.48	1.11	12.66	83.75	140.5
6000	4.04	0.17	1.427	0.302	20.222	0.08	2.88	12.60	84.45	75.5
6500	2.60	0.11	1.011	0.272	22.205	0.08	3.90	11.76	84.27	74

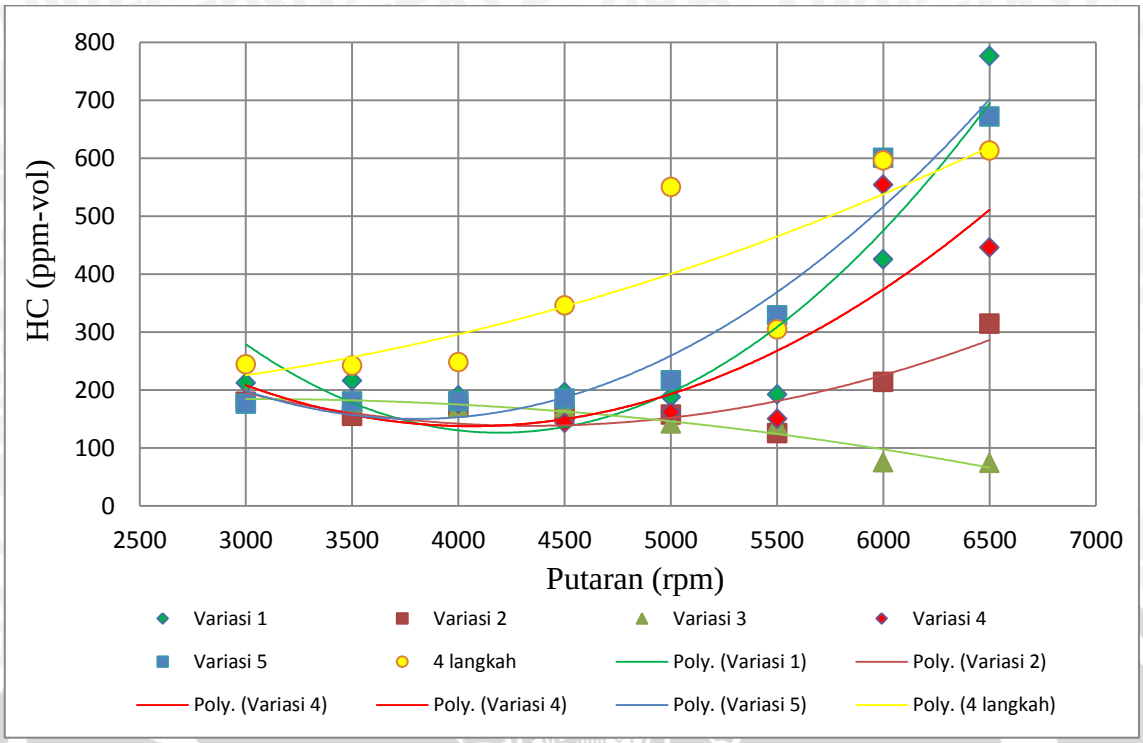
Lampiran 19. Data hasi lperhitungan rata-rata motor bakar 6 langkah variasi 4

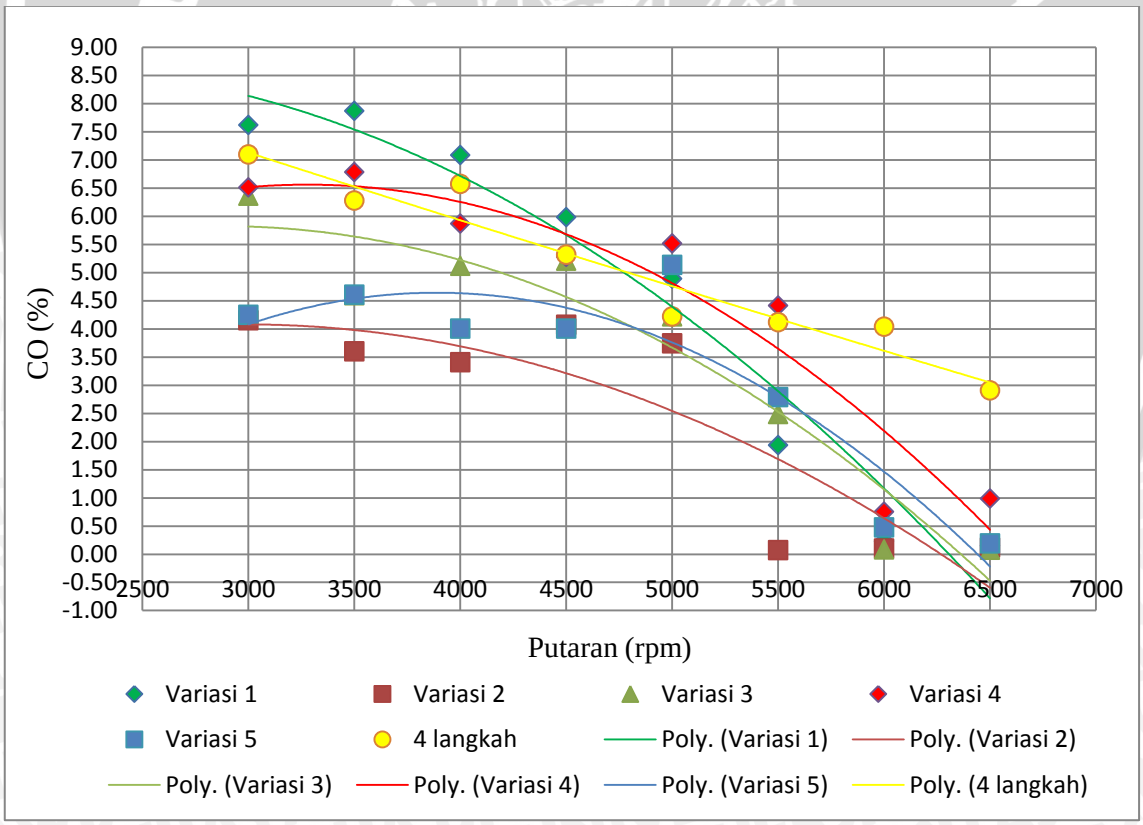
Variasi 4 (pengapian mundur 2°)										
Average										
n	Td	Tc	P	SFC_e	η_e	CO	O_2	CO_2	NO_2	HC
(rpm)	(kg·m)	(kg·m)	(hp)	(kg/hp·h)	%	(%vol)	(%vol)	(%vol)	(%vol)	(ppm-vol)
3000	14.85	0.66	2.751	0.168	35.696	6.51	0.49	10.05	82.95	183.5
3500	13.95	0.63	3.082	0.165	38.035	6.78	0.41	10.01	82.80	182.5
4000	12.51	0.56	3.125	0.220	27.810	5.86	0.41	10.50	83.24	176.5
4500	11.54	0.52	3.269	0.234	26.625	5.28	1.01	10.29	83.44	143.5
5000	8.76	0.39	2.752	0.300	24.752	5.51	0.18	11.07	83.24	161.5
5500	6.23	0.28	2.154	0.431	14.300	4.41	0.14	12.05	83.41	150.5
6000	3.82	0.17	1.412	0.484	12.369	0.75	1.59	12.89	84.78	554.5
6500	1.98	0.09	0.792	0.451	13.371	0.98	1.13	13.29	84.60	446

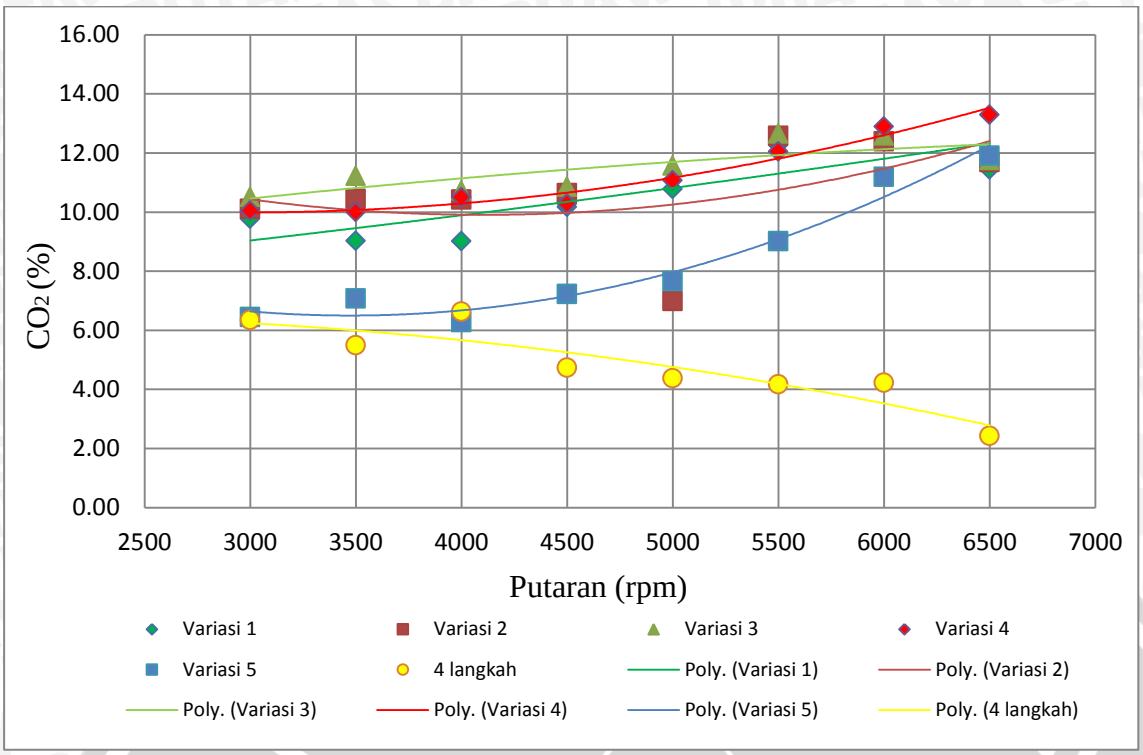
Lampiran 20. Data hasi lperhitungan rata-rata motor bakar 6 langkah variasi 5

Variasi 5 (pengapian mundur 4°)										
Average										
n	Td	Tc	P	SFC_e	η_e	CO	O_2	CO_2	NO_2	HC
(rpm)	(kg·m)	(kg·m)	(hp)	(kg/hp·h)	%	(%vol)	(%vol)	(%vol)	(%vol)	(ppm-vol)
3000	13.63	0.60	2.493	0.190	31.666	4.25	10.31	6.45	78.99	176.5
3500	11.41	0.52	2.523	0.160	37.408	4.61	7.52	7.08	80.80	180.5
4000	9.38	0.43	2.383	0.280	21.402	4.00	7.38	6.28	82.35	181
4500	8.35	0.37	2.344	0.346	18.908	4.01	6.33	7.23	82.44	185.5
5000	8.66	0.38	2.652	0.286	21.231	5.14	6.26	7.67	80.94	217
5500	6.88	0.31	2.353	0.349	17.480	2.78	5.04	9.02	83.16	329
6000	4.48	0.20	1.665	0.354	17.760	0.47	3.83	11.20	84.50	601
6500	1.70	0.07	0.680	0.726	8.285	0.19	3.46	11.91	84.45	672

Lampiran 21. Grafik emisi HC, CO, CO^2






16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
CO2 (%)
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
Putaran (rpm)
Variasi 1
Variasi 2
Variasi 3
Variasi 4
Variasi 5
4 langkah
Poly. (Variasi 1)
Poly. (Variasi 2)
Poly. (Variasi 3)
Poly. (Variasi 4)
Poly. (Variasi 5)
Poly. (4 langkah)