ALGORITHM DEVELOPMENT AND COMPUTATIONAL APPLICATIONS WITH PYTHON

TAKE-HOME MIDTERM EXAM

1. 2022-23 spring semester Python class consists of 10 students responsible for 6 assignments. Students' grades and assessment criteria for letter grade can be seen at Table 1 and Table 2, respectively. According to tables,

a. Calculate average of each of assignments. **(10 Points)**

b. Create a dictionary with student name and total point of him/her. **(10 Points)**

c. Create a function to obtain letter grade and pass-fail situation for each of students. **(10 Points)**

Table 1. Student Data

#	Student Name	Homework 1	Homework 2	Homework 3	Homework 4	Midterm	Final
1	Jack	25	65	80	50	75	30
2	Maria	100	20	45	90	40	45
3	Julia	85	90	70	85	90	85
4	David	45	50	20	100	85	100
5	Kevin	15	70	100	90	25	90
6	Lisa	0	40	60	45	65	10
7	Linda	60	35	5	0	15	15
8	Emily	95	25	60	60	25	75
9	Oliver	80	95	45	30	100	85
10	Alfie	55	10	70	15	80	40

Table 2. Contribution on Grading

Assignment	%	Score Interval	Letter Grade	
Homework 1	5	0-29	FF	FAIL
Homework 2	5	30-39	DD	
Homework 3	5	40-49	CC	PASS
Homework 4	5	50-59	CB	
Midterm	30	60-69	BB	

Final	50	70-79	BA	
TOTAL	100	80-100	AA	

2. Write a program to find the same elements in the lists given below. **(10 Points)**

A=[1, 6, -6, 32, 7, "exam", 0.01]

B=[8, 78, 4, 6, "exam", 4, 0.1**]**

3. According to experimental data (Table 3) of a Diesel engine with specifications in Table 4,

a.) Calculate effective torque (Nm), effective power (kW), brake mean effective pressure (bar), brake specific fuel (g/kWh) and volumetric efficiency for 4 steady-state test points (TP). **(15 Points)**

b.) Calculate the heat balance in proportions of heat for power, heat rejected to cooling, heat rejected to exhaust and heat rejected to overall friction for 4 steady-state test points (TP) and then print the results in an ascending sort. **(20 Points)**

You can call test points such as TP_1, TP_2, TP_3 and TP_4.

Table 3. Experimental Data

Engine Speed	Dyno Balance	Measured Fuel Volume	Time for fuel flow	Measured Air Volume	Time for air flow	Exhaust Gas Temperature	Mano. Diff. for Cooling Water Flow	Inflow Water Temperature	Outflow Water Temperature	Atmospheric Pressure	Ambient Air Temperature
n	F	V_{fuel}	Δt_{fuel}	V_{air}	Δt_{air}	$T_{exh,out}$	Δh_{Hg}	$T_{w,in}$	$T_{w,out}$	p_{air}	T_{air}
[rpm]	[N]	[cm^3]	[s]	[m^3]	[s]	[°C]	[mm]	[°C]	[°C]	[mbar]	[°C]
1750.00	205.00	50.00	17.50	2.00	49.40	576.40	179.00	81.90	89.80	1020.00	25.00
2100.00	175.00	50.00	15.70	2.00	43.04	575.00	190.00	81.00	88.00	1020.00	26.00
1900.00	180.00	50.00	16.61	2.00	47.64	580.00	180.00	83.00	89.00	1020.00	26.50
1700.00	205.00	50.00	17.98	2.00	51.63	573.00	185.00	80.00	90.00	1020.00	27.00

Table 4. Engine Specifications

Engine type	Diesel - 4 cylinders	**Compression ratio (ε)**	16,8
Stroke length	100 mm	**Bore diameter**	100
Stroke number per cycle	4	**Displacement**	3,14 liter

Table 5. Given values for calculations

Parameter	Value	Unit

b	0,955	m
V_H	3,14	litre
ρ_w	1000	kg/m^3
ρ_{fuel}	840.00	kg/m^3
ρ_{Hg}	13600	kg/m^3
R_{air}	0,287	kJ/kgK
c_w	4,20	kJ/kgK
c_{exh}	1,09	kJ/kgK
$d_{orifice}$	11,70	mm
$\alpha_{orifice}$	0,63	-
H_u	43.200	kJ/kg
Air-Fuel ratio @ λ=1	14,5	kg air/kg fuel
g	9,81	m/s^2

4. According to the Figure 1 below,

a.) Calculate H_A, R_A and M_A in kN, kN and kNm, respectively. **(10 Points)**

b.) Calculate the maximum bending moment in the system by dividing the whole length into 3 partitions indicated in Figure 1 (beam load is assumed as uniform and the angle with respect to the horizontal base P_1 exerts is 45°) **(15 Points)**

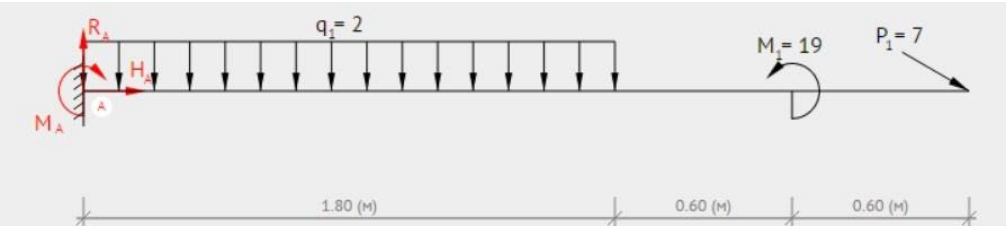

Figure 1. Uniform beam

- *You are allowed to import built-in Python libraries but not allowed to use shortcut commands giving the results directly.*

- *You are expected to use first nine weeks' structures such as* ***iteration, loops, string manipulation, functions, tuples, lists, aliasing, cloning, recursion, dictionaries****,* ***exceptions, assertions*** *and* ***Python classes*** *in your solutions.*
- *Explain all of your code lines with* ***#****. Students who do not prefer to comment the lines will get 0 points per question.*