Design Problem 1 – Aircraft Engine

Read the following statements thoroughly and follow through with the design assignment. Note the due date in the syllabus. This assignment should require about eight hours including the report. Your report should have a title page, a short one paragraph summary (like the labs), drawings, and calculations. Do your own work (no teams on this assignment please). Late assignments will suffer a 10% penalty per day.

Background. Most general aviation aircraft are small propeller driven airplanes powered by either a single or multiple SI engines. These engines have very special characteristics. They must be relatively light and very powerful. They generally are high compression (10:1 to 12:1) four or six cylinder four stroke engines fueled by 100 octane low lead gasoline. To avoid engine knock at full load they are magneto driven dual ignition (two spark plugs per cylinder). This also serves as a safety factor if one ignition system fails during take- off or at altitude.   The propeller is directly driven off the crankshaft to eliminate gearing. Since the propeller tip cannot exceed sonic velocity the engines must operate with a maximum speed of 2000 – 2500 rpm. Delivering this power (120 – 250 hp) at 2400 rpm requires very high torque, much higher than an automobile engine which generally delivers 150 to 250 hp at 6000 rpm with six or eight cylinders.

Assignment. Design an aircraft engine that fits the constraints below.   Assume the aircraft is at a take- off condition (full throttle, summer day, airport altitude conditions at Rapid City Regional – 3200 ft.). Include in your report drawings of the engine with dimensions. Please state all of your assumptions. (Assumptions include but are not limited to compression ratio, inlet conditions, compression pressure and temperature, peak pressure and temperature, exhaust pressure and temperature, inlet and exhaust valve diameter, valve lift, number of crankshaft bearings, crankshaft bearing length and diameter, connecting rod bearing length and diameter, number of camshafts, etc.)

Constraints:

Last Name begins with	Engine type	no of cylinders	speed	hp output
A - G	four stroke	4	2350	120
H - L	four stroke	6	2400	160
M - R	four stroke	4	2500	180
S - Z	four stroke	6	2400	210

Determine/estimate engine performance parameters (e.g., engine torque, bore and stroke, bmep, fmep, imep, IP, FP, bsfc, isfc, η_e, η_i, η_m, m_f and any other useful parameters).