SESA3029 Aerothermodynamics 2016-17 Examination Feedback

In order to obtain the highest marks, one had to solve Q2(iii) or Q4(ii) almost entirely correctly and only two students achieved a mark above 90%. Several students used pencil, which is not allowed, as noted on the booklets. About 10 students used red and green pen to annotate results etc., which causes issues with the marking process (first markers use red and second markers use green ink). It helps us if you stick to black or blue ink.

Q1. This was a straightforward question and the majority of students obtained good to very good marks: (i) The throat is at M=1, so from tables p=264 kA and T=350K (ii) Test section is at M=3, so p=13.6 kPa, T=150K. Almost everybody answered (i) and (ii) correctly. (iii) From OSC beta=30 deg, M1n=1.5 and p2=33.4 kPA, T2=198 K. (iv) sketch of a regular shock reflection (vi) M2=2.4, reflected shock angle 36 deg (same turning angle as impinging shock p3=71.8 kPa, T3=249.5 kPa. (vi) The sketch should now include a boundary layer with separation (or at least a thickening of the boundary layer) (vii) beta =46 deg, M2=1.62. Now the reflected shock has a turning angle larger than that allowed, so we get a Mach reflection. Some students exchanged the sketches of (vi) and (vii), which is an indication of a lack of physical understanding.

Q2. (i) Standard derivation. A large group of students performed very well on this part. (ii) DCL/dalpha=4/sqrt(M^2-1), tending to zero for large M and infinity for M approaching 1. Note that the blow-up at M=1 is not physical (we didn't carry enough terms in the derivation to be valid in this region). When one truly understands the derivation of (i), answering (ii) should be very straightforward. Yet several students, who reproduced the derivation under (i) well, struggled with (ii). (iii) CD=0.0094. There is no drag contribution from lower surface, so we just have to integrate Cpu*thetau, and you end up integrating a quadratic polynomial. About 10 students were able to answer this question correctly. Some students integrated over both surfaces and ended up with 2xCD. Several students tried to apply the memorised formula for CD for a diamond-shaped airfoil, obviously without any success. (iv) Although it is thin (which is good), the shape is not the optimal diamond shape. Answers to (iv) were quite varied.

Q3. Considering that we did a coursework exercise on MoC the answers to this questions were a bit disappointing. Part (i) was well answered, however a lot of the subsequent calculations went wrong quite early in the process. (ii) R-=nu+theta and we did the little proof in lectures. (iii) Note that the first characteristic (point 0 to point 1) starts after a turning of 3 degrees whereas the second characteristic (point 10 to point 2) starts from a turning of 6 degrees. R01-=3+3=6 degrees and at point 1 M=1.3. This characteristic starts from M=1.18, theta=3 deg. At point 1 x=0.76, taking the average conditions along the Mach line as usual. (iv) If the wall is aligned with the flow angle there is no reflected wave. (v) Point 2: R-=11.9, R+=6 deg. Theta2=2.95 deg, M2=1.4, Point 3 theta=0, R-=11.9, nu=11.9, M3=1.5 and the geometry formula given givens xp=0.89, yp=0.15. (intermediate results: alphaAP=49.41, alphaBP=-43.48).

Q4. Approximately 1/3 of students attempted this question and generally fared rather well. Q4. (i) is basic definitions, (ii) (a) Rex=205,307 is less than 300,000 so should be laminar. Basically everyone received full marks on (i) and (ii)-a. (b) you can write down h(x)=(known constants)*x^(-0.5) and then integration from 0 to 0.05m gives the average. 20.59 W. (b) was generally well solved. (c) One had to integrate the formula for Nux for a turbulent boundary layer from 0.05m to 0.3m, giving Q=128.03 W and then Q_total=148.62 follows. Despite being a somewhat canonical extension of (b), only a smaller number of students solved (c) entirely correctly. Some students had problems integrating x^(-0.2) correctly and reused the same formulas as under (ii). Several students integrated from 0 to 0.25m, which was an anticipated mistake. (iii) Only three students remembered to express the flux in the conserved variables, which makes this question easy to answer. Basically everybody attempting Q4 was able to find the eigenvalues of the 2*2 matrix.

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