MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
(A constituent institution of MAHE, Manipal)

V SEMESTER B. TECH (AERONAUTICAL ENGINEERING)
END-SEMESTER MAKE-UP EXAMINATION, FEB., 2022
COURSE: GAS DYNAMICS (AAE 3158)

REVISED CREDIT SYSTEM

Duration: 50 Mins **Date: 22/02/2022** **MAX. MARKS: 30**

PART-A

Note: All questions and compulsory and each question carry 1 mark.

Q1.	A gas is said to be incompressible if the variation in density is ____ 1. less than 5% 2. greater than 5% 3. greater than 10% 4. less than 10%
Q2.	For a real gas, _____ 1. Both C_p and C_v are dependent on temperature 2. C_p is independent and C_v is dependent on temperature 3. C_p is dependent and C_v is independent of temperature 4. Both C_p and C_v are independent of temperature
Q3.	In finite control volume approach, the region under study has _____ 1. infinitesimal volume 2. finite volume 3. either infinitesimal or finite volume 4. none of above
Q4.	The characteristic properties correspond to _____. 1. subsonic flow 2. supersonic flow 3. sonic flow 4. hypersonic flow
Q5.	Second law of thermodynamics deals with the _____. 1. direction of heat transfer 2. amount of heat transfer 3. conversion of one form on energy into another 4. energy conservation
Q6.	Internal energy is an _____ property 1. Intensive 2. Extensive 3. May be intensive or extensive 4. None of above

Q7.	The intermolecular forces can be neglected at ___ 1. high pressure and high temperature 2. high pressure and low temperature 3. low pressure and low temperature 4. low pressure and high temperature
Q8.	Hypersonic flow takes place over a wing that is kept at an angle of attack of 8^o. According to the Newtonian theory, the pressure coefficient on the suction surface is _____ 1. 0 2. 0.158 3. 0.193 4. 0.276
Q9.	Hypersonic flow takes place over a wing that is kept at an angle of attack of 17^o. The difference in pressure coefficient on the two sides of the wing is 0.61. According to the exact shock wave theory, the lift-to-drag ratio is _____ 1. 4.12 2. 3.67 3. 3.22 4. 4.75
Q10.	A flat plate is kept at an angle of 18^o in a Mach 5 flow. The Mach number on the top surface of the plate is ____ 1. 9.5 2. 8.6 3. 6.3 4. 7.8
Q11.	The boundary layer thickness is high for _____ flows. 1. hypersonic 2. subsonic 3. supersonic 4. sonic
Q12.	For Mach 8 flow, the wedge angle is 12^o. The shock angle is ____. 1. 14.4^o 2. 10^o 3. 9.6^o 4. 14.8^o
Q13.	For hypersonic flow, the ratio of inlet to outlet density corresponding to adiabatic index of 1.4 is ____ 1. 4.6 2. 5.8 3. 6 4. 8.2
Q14.	For the same half-cone and half-wedge angles, the intensity of shock wave, the intensity of shock wave will be lower for the _____ surface.

	1. cone 2. wedge 3. same for both 4. none of above
Q15.	For supersonic flow, with increase in cone angle, the shock wave becomes _____ 1. attached 2. detached 3. may be attached or detached 4. none of above
Q16.	When the slope of characteristic line gives one real characteristics, the resulting flow is _____ 1. Hypersonic 2. sonic 3. supersonic 4. subsonic
Q17.	In supersonic flows, the maximum cone angle is ____ the maximum wedge angle. 1. smaller than 2. equal to 3. greater than 4. none of above
Q18.	In supersonic nozzle design, the expansion section _____ 1. has large length 2. shrinks to a point 3. has shorter length 4. none of above
Q19.	For the same Mach number, the minimum length nozzles have _____ duct wall angle than the supersonic nozzles. 1. larger 2. smaller 3. equal 4. may be large or small
Q20.	In a 2D, steady and supersonic flow, the two characteristic lines make a Mach angle of 6^o. The flow is deflected by 13^o. The slope of right running characteristic line is _____ 1. 0.29 2. 0.23 3. 0.18 4. 0.12
Q21.	In compressibility correction, _____gives the more accurate solution 1. Karman-Tsien rule 2. Laitone correction 3. Prandtl-Glauert rule 4. none of above.

Q22.	For supersonic flow, the increase in area results in ____ in velocity. 1. reduction 2. increase 3. no change 4. none of above
Q23.	When the nozzle exit pressure reduces below the back pressure, the nozzle becomes _____. 1. over-expanded 2. under-expanded 3. completely expanded 4. none of above
Q24.	A mixture of hydrogen and oxygen enters the combustion chamber at 2100 K and 13 atm. The molecular weight of the gas is 16 and $\gamma = 1.24$. The pressure at the exit of convergent-divergent nozzle is 105×10^{-4} atm. Throat area is 0.26 m^2. Assuming a calorically perfect gas, the characteristic density is _____kg/m^3. 1. 0.855 2. 0.936 3. 0.712 4. 0.748
Q25.	A mixture of hydrogen and oxygen enters the combustion chamber at 2100 K and 13 atm. The molecular weight of the gas is 16 and $\gamma = 1.24$. The pressure at the exit of convergent-divergent nozzle is 105×10^{-4} atm. Throat area is 0.26 m^2. Assuming a calorically perfect gas, the characteristic speed of sound is _____m/s. 1. 1099 2. 1123 3. 1034 4. 1187
Q26.	An oblique shock wave incidents on a solid surface and reflects from there. The reflected wave is ____ in nature. 1. expansion wave 2. compression wave 3. normal shock wave 4. none of above
Q27.	In oblique shock diffuser, the second throat area must be ____ than the first throat area 1. larger 2. smaller 3. equal 4. none of above
Q28.	Across the expansion wave, the static pressure ___. 1. increases 2. remains same

	3. initially increases and then reduces 4. reduces
Q29.	For supersonic flows, the effect of heat addition causes _____ in velocity 1. increase 2. reduction 3. no change 4. none of above
Q30.	For a given shock wave angle, increase in Mach number causes _____ in deflection angle 1. increase 2. reduction 3. no change 4. none of above

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Duration: 75 Mins (+10 mins uploading time) **Date: 22/02/2022** **MAX. MARKS: 20**

Note:

- *All questions are compulsory*
- *Draw a neat diagram wherever necessary*
- *Stepwise answers carry marks*
- *Refer the property table attached with this question paper*

Q1.	Write a note on thin shock layers in hypersonic flows	**[2M]**
Q2.	Derive the Crocco's theorem.	**[3M]**
Q3.	Air enters a 3.5 cm diameter pipe with stagnation pressure and temperature of 100 kPa and 320 K, respectively and velocity of 120 m/s. Determine the i. mass flow rate and ii. maximum pipe length for this mass flow rate. Take f = 0.02.	**[5M]**
Q4.	Write different applications of gas dynamics.	**[2M]**
Q5.	Explain the working principle of laser Doppler anemometry.	**[3M]**
Q6.	Mach 1.8 flow has static pressure of 2.8 kPa and static temperature of 264 K. This flow experiences an expansion corner which deflects the stream by an angle of 20^o. Determine the flow properties behind the expansion wave and angles of forward and rearward Mach lines made with respect to the upstream flow direction.	**[5M]**