ASSIGNMENT 12

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1) The integration $\int_0^1 x^3\,dx$ computed using the trapezoidal rule with $n = 4$ intervals is.
2) An aircraft has a steady rate of climb of $300\,\frac{m}{s}$ at sea level and $150\,\frac{m}{s}$ at $2500\,\text{m}$ altitude. The time taken $(insec)$ for this aircraft to climb from $500\,\text{m}$ altitude to $3000\,\text{m}$ altitude is.
3) An airfoil generates a lift of $80\,\text{N}$ when operating in a freestream flow of $60\,\frac{m}{s}$. If the ambient pressure and temperature are $100\,\text{kPa}$ and $290\,\text{K}$ respectively specific gas constant is $287\,\Im kg - K$, the circulation on the airfoil in m^2/s is.
4) A rocket motor has combustion chamber temperature of $2600\,\text{K}$ and the products have molecular weight of $25\,\frac{g}{mol}$ and ratio of specific heats 1.2. The universal gas constant is $8314\,\frac{J}{kg-mole-K}$. The value of theoretical c^* $\left(in\frac{m}{s}\right)$ is.
5) The mode shapes of an un-damped two degrees of freedom system are $\begin{Bmatrix}1\\0.5\end{Bmatrix}^T$ and $\begin{Bmatrix}1\\-0.675\end{Bmatrix}^T$. The corresponding natural frequencies are $0.45\,\text{Hz}$ and $1.2471\,\text{Hz}$. The maximum amplitude $(inmm)$ of vibration of the first degree of freedom due to an initial displacement of $\begin{Bmatrix}2\\1\end{Bmatrix}^T$ $(inmm)$ and zero initial velocities is.
6) The n^{th} derivative of the function $y = \frac{1}{x+3}$ is:
   a) $\frac{(-1)^n n!}{(x+3)^{n+1}}$
   b) $\frac{(-1)^{n+1} n!}{(x+3)^{n+1}}$
   c) $\frac{(-1)^n (n+1)!}{(x+3)^n}$
   d) $\frac{(-1)^n n!}{(x+3)^n}$
7) The volume of a solid generated by rotating the region between semi-circle $y = 1 - \sqrt{1-x^2}$ and straight line $y = 1$, about x-axis, is:
   a) $\pi^2 - \frac{4}{3}\pi$
   b) $4\pi^2 - \frac{1}{3}\pi$
   c) $\pi^2 - \frac{3}{4}\pi$
   d) $\frac{3}{4}\pi^2 - \pi$
8) One eigenvalue of the matrix $A = \begin{bmatrix}2 & 7 & 10\\5 & 2 & 25\\1 & 6 & 5\end{bmatrix}$ is -9.33. One of the other eigenvalues is:
   a) 18.33
   b) -18.33

c) $18.33 - 9.33i$
d) $18.33 + 9.33i$

9) If an aircraft takes off with 10% less fuel in comparison to its standard configuration, its range is:
   a) Lower by exactly 10%.
   b) Lower by more than 10%.
   c) Lower by less than 10%.
   d) An unpredictable quantity.

10) An aircraft has an approach speed of $144\,\text{kmph}$ with a descent angle of $6.6°$. If the aircraft load factor is 1.2 and constant deceleration at touch down is $0.25g$ $\left(g = 9.81\,\frac{m}{s}^2\right)$, its total landing distance approximately over a $15\,\text{m}$ high obstacle is:
   a) $1830\,\text{m}$
   b) $1380\,\text{m}$
   c) $830\,\text{m}$
   d) $380\,\text{m}$

11) An oblique shock wave with a wave angle β is generated from a wedge angle of θ. The ratio of the Mach number downstream of the shock to its normal component is:
   a) $\sin(\beta - \theta)$
   b) $\cos(\beta - \theta)$
   c) $\sin(\theta - \beta)$
   d) $\cos(\theta - \beta)$

12) In a closed-circuit supersonic wind tunnel, the convergent-divergent $(C - D)$ nozzle and test section are followed by a $C - D$diffuser to swallow the starting shock. Here, we should have the:
   a) Diffuser throat larger than the nozzle throat and the shock located just at the diffuser throat.
   b) Diffuser throat larger than the nozzle throat and the shock located downstream of the diffuser throat.
   c) Diffuser throat of the same size as the nozzle throat and the shock located just at the diffuser throat.
   d) Diffuser throat of the same size as the nozzle throat and the shock located downstream of the diffuser throat.

13) An aircraft is trimmed straight and level at true air speed (TAS) of $100\frac{m}{s}$ at standard sea level (SSL). Further, pull of $5N$ holds the speed at $90\frac{m}{s}$ without re-trimming at SSL air density = $1.22 kg\text{m}^3$. To fly at 3000 m altitude air density = $0.91 kg\text{m}^3$ and $120\left(\frac{m}{s}\right)$ TAS without re-trimming, the aircraft needs:
   a) $1.95N$ upward force
   b) $1.95N$ downward force
   c) $1.85N$ upward force
   d) $1.75N$ downward force