



M.TECH DEGREE EXAMINATIONS: APRIL / MAY 2023

(Regulation 2018)

Second Semester

DEFENCE TECHNOLOGY

P18DTT2007: Aerospace System Configuration, Design & Simulation

COURSE OUTCOMES

CO1: Understand the concept of missile system and its design requirements and process.

CO2: Design an aerospace vehicle and articulate its benefits in written and verbal forms

CO3: Understand the methods for aero-elastic analysis, computational fluid analysis and advances in aerodynamics.

CO4: Understand the air to air, ground to air, air to ground weapon system, UAV mounted GW and UCAVs

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 10 = 100 Marks)

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|----|----|---|----|-----|-------------------|
| 1 | a) | Name the following Indian missiles:
i) Surface-to-Air missile ii) Air-to-Air missile iii) Long range Ballistic Missile and iv) Anti-tank missile | 4 | CO4 | [K ₂] |
| | b) | What is a guided missile? Enumerate the difference between ballistic missile and cruise missile with suitable examples. | 6 | CO4 | [K ₂] |
| 2. | | Discuss forced and free vibrations.
For a damped system, m, c and k are given as m=1 kg, c=2 kg/s and k=10 N/m. Calculate the value of damping ratio (ξ) and natural frequency (ω_n). Is the system overdamped, underdamped or critically damped? | 10 | CO3 | [K ₃] |
| 3. | a) | List out phenomena under static aeroelasticity and dynamic aeroelasticity. | 4 | CO3 | [K ₂] |
| | b) | Define aeroelasticity. Draw a simple Collar triangle and discuss the interaction between various aeroelastic forces. | 6 | CO3 | [K ₂] |

4.	a)	Derive the relation for pressure distribution. Find the pressure coefficient on a flat plate inclined at 10 deg to the incoming flow at hypersonic Mach number using Newtonian impact theory	8	CO2	[K ₃]
	b)	Describe Newtonian impact theory.	2	CO2	[K ₂]
5.	a)	Write the equations of i) First-order forward difference method and ii) First-order backward difference method in CFD	4	CO3	[K ₂]
	b)	Discuss aeroelastic flutter and buffeting.	6	CO3	[K ₂]
6.	a)	With a neat sketch, derive the relation for an airplane in power-off gliding flight	7	CO2	[K ₂]
	b)	The minimum gliding angle (corresponding to max. L/D) of an aircraft is 3 deg. What is the maximum Lift to Drag ratio of the aircraft?	3	CO2	[K ₃]
7	a)	Define i) Stick-fixed neutral point ii) Static margin iii) Elevator power iv) Trim condition	4	CO3	[K ₂]
	b)	Discuss static stability and dynamic stability. How does the location of CG affect the static stability?	6	CO3	[K ₂]
8	a)	What is first order system? Derive the homogenous solution of first order system.	7	CO2	[K ₂]
	b)	Solve the following first-order differential equation $\frac{dx}{dt} + 2x = 0$ Subject to the initial condition: $x(0) = 1$	3	CO2	[K ₃]
9	a)	What is lateral stability? Draw a sketch of rolling moment coefficient (C _l) Vs side slip angle (β) indicating slopes for positive and negative lateral stability.	4	CO3	[K ₂]
	b)	What is directional stability? Discuss the effect of wing sweepback on directional stability.	6	CO3	[K ₂]
10		What is an UCAV? Discuss the military applications of UCAV. Name two Indian UAVs.	10	CO4	[K ₂]
