Name:

Enrolment No:

UPES

End Semester Examination, May 2025

Course: Design of Aerospace Systems — **Semester: VI**

Program: B.Tech. Aerospace Engineering — **Time : 03 hrs.**

Course Code: ASEG3035 — **Max. Marks: 100**

Instructions:

- *Read all the questions carefully before attempting.*
- *Write legibly and neatly. Illegible answers may not be evaluated.*
- *Show all necessary calculations and assumptions clearly.*
- *Use appropriate formulas, standard values.*
- *Thers is a choice in Section-C, read carefully before attempting*
- *If any extra question found in the answer sheet that would not be marked and marked as over attempt.*
- *Units must be mentioned in all numerical answers.*

SECTION A
(5Qx4M=20Marks)

S. No.	Statement of question	Marks	CO
Q1.	What is permissible shear stress as per the ASME Code?	**4**	**CO1**
Q2.	What is 'self-locking' of power screw? What is the condition for self-locking?	**4**	**CO1**
Q3.	Why is the efficiency of self-locking square threaded screw less than 50%?	**4**	**CO1**
Q4.	Classify the different types of loads that can act on machine components.	**4**	**CO1**
Q5.	What is the function of transmission shaft? Why is the transmission shaft stepped?	**4**	**CO1**

SECTION B
(4Qx10M= 40 Marks)

Q6.	A pair of helical gears consists of a 25 teeth pinion meshing with a 50 teeth gear. The normal module is 4 mm. Find the required value of the helix angle, if the centre distance is exactly 165 mm.	**10**	**CO2**
Q7.	A ball bearing with a dynamic load capacity of 22.8 kN is subjected to a radial load of 10 kN. Calculate (i) the expected life in million revolutions that 90% of the bearings will reach; (ii) the corresponding life in hours, if the shaft is rotating at 1450 rpm; and (iii) the life that 50% of the bearings will complete or exceed before fatigue failure.	**10**	**CO2**
Q8.	A solid circular shaft of diameter *d* is subjected to a bending moment of *Mb* and a torsional moment of *Mt*. Prove that according to the maximum principal stress theory, $\frac{S_{yt}}{(fs)} = \frac{16}{\pi d^3}\left[M_b + \sqrt{(M_b)^2 + (M_t)^2}\right]$	**10**	**CO3**

Q9.	Derive expressions for equivalent bending moment and equivalent torsional moment for a solid shaft subjected to combined bending and torsion. Assume any theory of failure.	**10**	**CO3**
	SECTION-C **(2Qx20M=40 Marks)**		
Q10.	a) A solid shaft of diameter d is used in power transmission. Due to modification of the existing transmission system, it is required to replace the solid shaft by a hollow shaft of the same material and equally strong in torsion. Further, the weight of the hollow shaft per meter length should be half of the solid shaft. Determine the outer diameter of the hollow shaft in terms of d. **(10)** b) Name the various types of ball and roller bearings. Why are ball and roller bearings called "antifriction" bearings? Explain the procedure of selection of bearing from manufacturers catalogue. **(10)** **OR** c) A propeller shaft is required to transmit 45 kW power at 500 rpm. It is a hollow shaft, having an inside diameter 0.6 times of outside diameter. It is made of plain carbon steel and the permissible shear stress is 84 N/mm^2. Calculate the inside and outside diameters of the shaft. **(10)** d) Which one of the three listed below will you choose to take heavy axial load on the bearing. i. Self-aligning ball bearing ii. Deep grove ball bearing iii. Thrust Bearing. Give reason for your selection **[06]** e) Differentiate between thick film and thin film lubrication **[04]**	**20**	**CO4**
Q11	(a) What are the two methods to increase the efficiency of a square threaded screw? **(8)** (b) A double-threaded power screw, used for lifting a load, has a nominal diameter of 30 mm and a pitch of 6 mm. The coefficient of friction at the screw threads is 0.1. Neglecting collar friction, calculate: (i) efficiency of the screw with square threads; and (ii) efficiency with Acme threads ($2\theta = 29°$). **(12)** **OR** A hollow circular shaft of outer and inner diameters of d_0 and d_i respectively is subjected to a torsional moment of M_t over a length l. The permissible angle of twist is θ degrees. Prove that the shaft diameter is given by, $d_0 = \left[\frac{584\, M_t l}{G\theta\,(1-C^4)}\right]^{1/4}$ where, $C = d_i / d_0$ **(20)**	**20**	**CO4**