

--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: VI - THEORY EXAMINATION (2025 - 2026)

Subject: Design of Machine Elements

Time: 3 Hours

Max. Marks: 100

General Instructions:

IMP: Verify that you have received the question paper with the correct course, code, branch etc.

1. This Question paper comprises of **three Sections -A, B, & C**. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.
2. Maximum marks for each question are indicated on right -hand side of each question.
3. Illustrate your answers with neat sketches wherever necessary.
4. Assume suitable data if necessary.
5. Preferably, write the answers in sequential order.
6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION-A

20

1. Attempt all parts:-

- | | | |
|-------|--|---|
| (1.1) | What are machine elements? (CO1, K1) | 1 |
| (a) | The moving parts of a machine | |
| (b) | The individual parts or components of a machine that perform specific functions | |
| (c) | The tools used to manufacture machines | |
| (d) | The electronic components of a machine | |
| (1.2) | What is the primary consideration in selecting materials for static loads? (CO1, K1) | 1 |
| (a) | The material's strength and stiffness | |
| (b) | The material's toughness and ductility | |
| (c) | The material's corrosion resistance | |
| (d) | The material's cost-effectiveness | |
| (1.3) | Which of the following is the correct definition of cyclic stress? (CO2, K1) | 1 |
| (a) | Stress that is constant over time | |
| (b) | Stress that varies over time | |
| (c) | Stress that only occurs in metals | |
| (d) | Stress that only occurs in non-metal materials | |
| (1.4) | What are the limitations of the Gerber criterion? (CO2, K1) | 1 |
| (a) | It is only applicable to ductile materials | |
| (b) | It is only applicable to brittle materials | |
| (c) | It does not take into account the effects of stress concentration | |
| (d) | It does not take into account the effects of temperature on the material | |
| (1.5) | Which tooth form is most commonly used for spur gears? (CO3, K1) | 1 |

- (a) Cycloidal
 - (b) Involute
 - (c) Epicycloidal
 - (d) Hypocycloidal
- (1.6) Which of the following is not a common tooth form for bevel gears?(CO3, K1) 1
- (a) Straight bevel
 - (b) Spiral bevel
 - (c) Hypoid
 - (d) Cycloidal
- (1.7) Which force is responsible for transmitting power in a bevel gear system? (CO4, k2) 1
- (a) Axial force
 - (b) Tangential force
 - (c) Radial force
 - (d) None of the above
- (1.8) The effective load on a bevel gear tooth is: (CO4, K1) 1
- (a) The maximum load that the tooth can bear
 - (b) The load acting on the tooth in the direction of the tooth's normal
 - (c) The load acting on the tooth in the direction of the gear's pitch line
 - (d) The load acting on the tooth in the direction of the gear's axis
- (1.9) Which of the following is not a type of sliding contact bearing? (CO5, K1) 1
- (a) Thrust bearing
 - (b) Pivot bearing
 - (c) Collar bearing
 - (d) Ball bearing
- (1.10) What is the effect of excessive heat generation in a sliding contact bearing? (CO5, K1) 1
- (a) Increased bearing life
 - (b) Decreased bearing life
 - (c) No effect on bearing life
 - (d) Improves the performance of the bearing

2. Attempt all parts:-

- (2.1) Distinguish between design and analysis. (CO1, K2) 2
- (2.2) What is stress concentration? (CO2, K1) 2
- (2.3) State applications of gear drives. (CO3, K2) 2
- (2.4) What is a worm gear? (CO4, K1) 2
- (2.5) What is a fluid film bearing? (CO5, K1) 2

SECTION-B

30

Answer any one of the following:-

- (3.1) Enumerate the various manufacturing methods of machine parts which a designer 6

	should know. (CO1, K2)	
(3.2)	What is the permissible shear stress as per the ASME Code? (CO1, K2)	6
	Answer any one of the following:-	
(3.3)	What are the causes of stress concentration? Also Explain the effect of stress concentration during design of component. (CO2, K3)	6
(3.4)	What is fluctuating stress? Draw a stress–time curve for fluctuating stress. (CO2, K2)	6
	Answer any one of the following:-	
(3.5)	State important reasons for adopting involute curve for gear tooth profile. (CO3, K2)	6
(3.6)	Derive Lewis equation for gear design. (CO3, K3)	6
	Answer any one of the following:-	
(3.7)	How do you calculate the virtual number of teeth in a bevel gear system? (CO4, K2)	6
(3.8)	What factors should be considered when selecting materials for bevel gears? (CO4, K2)	6
	Answer any one of the following:-	
(3.9)	Discuss the important properties of bearing materials. (CO5, K2)	6
(3.10)	What is a self-aligning ball bearing, and what are its advantages? (CO5, K2)	6
	SECTION-C	50
	4. Answer any <u>one</u> of the following:-	
(4.1)	Explain the different theory of failure in detail. (CO1, K2)	10
(4.2)	A shaft running at 400 r.p.m. transmits 10 kW. Assuming allowable shear stress in shaft as 40 MPa, find the diameter of the shaft. (CO1, K3)	10
	5. Answer any <u>one</u> of the following:-	
(5.1)	It is required to design a helical compression spring subjected to a maximum force of 7.5 kN. The mean coil diameter should be 150 mm from space consideration. The spring rate is 75 N/mm. The spring is made of oil-hardened and tempered steel wire with ultimate tensile strength of 1250 N/mm ² . The permissible shear stress for the spring wire is 30% of the ultimate tensile strength ($G = 81\,370\text{ N/mm}^2$). Calculate (i) wire diameter; and (ii) number of active coils (CO2, K3)	10
(5.2)	A rotating bar made of steel 45C8 ($S_{ut} = 630\text{ N/mm}^2$) is subjected to a completely reversed bending stress. The corrected endurance limit of the bar is 315 N/mm ² . Calculate the fatigue strength of the bar for a life of 90,000 cycles. (CO2, K3)	10
	6. Answer any <u>one</u> of the following:-	
(6.1)	It is required to design a pair of spur gears with 20° full-depth involute teeth based on the Lewis equation. The velocity factor is to be used to account for dynamic load. The pinion shaft is connected to a 10 kW, 1440 rpm motor. The starting torque of the motor is 150% of the rated torque. The speed reduction is 4 : 1. The pinion as well as the gear is made of plain carbon steel 40C8 ($S_{ut} = 600\text{ N/mm}^2$). The factor of safety can be taken as 1.5. Design the gears, specify their dimensions and suggest suitable surface hardness for the gears. (CO3, K3)	10

- (6.2) Discuss a general procedure for designing a spur gear.(CO3, K3) 10
7. Answer any one of the following:-
- (7.1) Explain the steps involve in design a worm gearing system? (CO4, K3) 10
- (7.2) A pair of bevel gears consists of a 30 teeth pinion meshing with a 48 teeth gear. The gears are mounted on shafts, which are intersecting at right angles. The module at the large end of the tooth is 4 mm. Calculate 10
- (i) the pitch circle diameters of the pinion and the gear;
 - (ii) the pitch angles for the pinion and gear; and
 - (iii) the cone distance. (CO4, K3)
8. Answer any one of the following:-
- (8.1) Explain the following: (CO5, K2) 10
- (a) Static Load Capacity
 - (b) Dynamic load capacity
 - (c) L_{10} Life
- (8.2) A single-row deep groove ball bearing is subjected to a pure radial force of 3 kN from a shaft that rotates at 600 rpm. The expected life L_{10h} of the bearing is 30 000 h. The minimum acceptable diameter of the shaft is 40 mm. Select a suitable ball bearing for this application. (CO5, k3) 10