



SF-7161

B. E. - III (Sem. VI) (Mech.) Examination
May / June - 2011
Machine Design-I

Time : Hours]

[Total Marks : 100

Instructions :

(1)

नीचे दृष्टावेक निशानीवाणी विगतो उत्तरवडी पर अवश्य लपवी. Fillup strictly the details of signs on your answer book.	Seat No. :
Name of the Examination :	<input type="text"/>
<input type="text" value="B. E. - III (Sem. VI) (Mech.)"/>	<input type="text"/>
Name of the Subject :	<input type="text"/>
<input type="text" value="Machine Design - I"/>	<input type="text"/>
Subject Code No. : <input type="text" value="7"/> <input type="text" value="1"/> <input type="text" value="6"/> <input type="text" value="1"/>	<input type="text"/>
Section No. (1, 2,.....): <input type="text" value="Nil"/>	<input type="text"/>
	<input type="text" value="Student's Signature"/>

- (2) Attempt all questions.
- (3) Figure to the right indicate marks.
- (4) Assume suitable data, if required.
- (5) Draw neat sketches to justify the answer.

- 1 (a) Answer the following : (Any three) 09
- (i) Define machine design. Classify the different types of design problem and explain it giving suitable examples.
 - (ii) List and explain the factors affecting fatigue strength of a component.
 - (iii) Explain the different types of end closures in pressure vessels.
 - (iv) Briefly write about limit, fits and tolerances.
- (b) The following data refers to a transmission shaft which carries a pulley midway between two bearings :-
Bending moment varies from = 200 Nm to 600 Nm.
Torsional moment varies from = 70 Nm to 200 Nm.
For shaft material - FeE 400, $\sigma_{ut} = 540$ Mpa,
 $\sigma_{yt} = 400$ Mpa corrected endurance strength for shaft = 200 Mpa. factor of safety = 2
The frequencies of variation of bending and torsional moments are Equal to shaft speed. Determine the diameter of shaft.

- 2 (a) Suggest the suitable screw threads giving reasons for the following applications : 15
- (i) Screw jack (ii) Lead screw of machine (iii) vices.
- (b) A screw clamp with double start square thread is capable of exerting a compressive force of 10 kN on the job, through an effort of 200 N at the end of handle of radius 250 mm. needs to be designed. Find the screw diameter and length of the nut. The material for the nut is C.I. (FG 220) and screw is made of plain carbon steel 30c8 with $\sigma_{ult} = 500$ Mpa and $\sigma_{yt} = 400$ MPa. Take factor of safety as 3. The coefficient of friction is 0.15. Take collar diameter 0.8d to 0.2d, where d is nominal diameter of the screw. Suggest suitable normal series square threaded screw.

OR

- (b) A double start square threaded screw used in a screw jack, has outside dia. of 50 mm and pitch of 10 mm. The outside diameter of the collar is 80 mm and inside diameter is 12 mm. Load lifting capacity is 50 kN and $\mu = 0.15$. Calculate (i) Principal compressive stress in screw. (ii) Length and diameter of handle, if the effort applied at the end of handle is 300N and permissible tensile stress is 80 MPa. (iii) The bearing pressure between screw and nut for 70 mm height of nut. (iv) Shear stress in nut and screw threads for 70 mm height of nut. 15
- 3 (a) Design a knuckle joint to transmit 40 kN load. 12
- The design stresses are $\sigma_7 = 60$ MPa, $\tau = 35$ MPa, $\sigma_{cr} = 70$ MPa and $\sigma_{bearing} = 15$ MPa. consider the rods with circular cross-section.

OR

- (a) Design a spigot and socket type cotter joint transmit a reversible load of 35 kN. The allowable stresses are in tension, shear and crushing are 80 MPa, 50 MPa and 100 MPa respectively, consider 25% higher load for joint design. 12
- (b) Compare thin and thick cylinder. 03

- 4 (a) Answer the following questions (Any four) **08**
- (1) Explain “Leverage” & “Mechanical Advantage”.
 - (2) Differentiate between closed coiled & open coiled helical springs.
 - (3) What are the factors to be considered while selecting the types of key ?
 - (4) Explain the difference between “A Clutch” & “A Coupling”,
 - (5) What do you understand by “Torsional Rigidity” and “Lateral Rigidity”.
- (b) Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32 k W at 960 r.p.m. the overall torque is 20% more than mean torque. The material properties are as follows : **12**
- (a) The allowable shear & crushing stress for shaft & key material is 40 MPa & 80 MPa respectively.
 - (b) The allowable shear stress for C.I. is 15 MPa.
 - (c) The allowable bearing pressure for rubber bush is 0.8 N/mm².
 - (d) The material of the pin is same as that of shaft & key.
- 5 (a) Design a shaft to transmit power from an electric motor to a lathe head stock through a pulley by means of a belt drive. The pulley weights 200 N and is located at 300 mm from the centre of the bearing. The diameter of the pulley is 200 mm and the maximum power transmitted is 1 kW at 120 r.p.m. The angle of lap of the belt is 180⁰ and μ is 0.3. The shock and fatigue factors for bending and twisting are 1.5 and 2.0 respectively. The allowable shear stress in the shaft may be taken as 35 MPa. **06**
- (b) A hollow steel shaft is to transmit 20 kW at 300 r.p.m. The loading is such that the max. bending moment is 1000 N-m, the max, torsional moment is 500 N-m & axial compressive load is 15 kN. The shaft is supported on rigid bearings 1.5 m apart. The max, permissible shear stress on the shaft is 40 MPa. The inside dia. is 0.8 times the outside dia. The load is cyclic in nature & applied with shocks. The values for the shock factors are $K_t = 1.5$ & $K_m = 1.6$. **09**

OR

- (b) A shaft is supported on bearings A & B, 800 mm between centres. A 20° straight tooth spur gear having 600 mm pitch diameter, is located 200 mm to the right of the left hand bearing A, & a 700 mm dia. pulley is mounted 250 mm towards the left of bearing B. The gear is driven by a pinion with a downward tangential force while the pulley drives a horizontal belt having 180° angle of wrap. The pulley also serves as a flywheel & weights 2000 N. The max. belt tension is 3000 N & the tension ratio is 3:1. Determine the max. bending moment & the necessary shaft dia. if the allowable shear stress of the material is 40 MPa. 15
- 6 (a) Design a leaf spring for the following specifications: 07
 Total load = 140 kN; Number of springs supporting the load = 4; Max. No. of leaves = 10; Span of the spring = 1000 mm; Permissible deflection = 80 mm. Take young's modulus = 200 kN/mm² & allowable stress in spring material as 600 MPa.
- (b) Design a close coiled helical compression spring 08
 for a service load ranging from 2250 N to 2750 N. the axial deflection of the spring for the load range is 6 mm. Assume a spring index of 5. The permissible shear stress intensity is 420 MPa & modulus of rigidity is 84 kN/mm².

OR

- (b) A lever loaded safety valve is 70 mm in dia. and 15
 is to be designed for a boiler to blow-off at pressure of 1 N/mm² gauge. Design a suitable mild steel lever of rectangular c/s using the following permissible stresses: Tensile stress = 70 Mpa; Shear stress = 50 Mpa; Bearing pressure = 25 N/mm². The pin is also made of mild steel. The distance from the fulcrum to the weight of the lever is 880 mm and the distance between the fulcrum & pin connecting the valve spindle links to the lever is 80 mm.