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Total No. of printed pages = 8

ME 131604

Roll No. of candidate

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2017

B.Tech 6th Semester End-Term Examination

MACHINE DESIGN

Full Marks-100 Pass Marks-35 Time-Three hours

The figures in the margin indicate full marks
for the questions.

1. Answer *all* questions : $10 \times 1 = 10$
- (i) Which of the following material has maximum ductility
- (a) Mild steel
 - (b) Copper
 - (c) Nickel
 - (d) Aluminium ?

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- (ii) The hardness is the property of a material due to which it :
- (a) can be drawn into wires
 - (b) breaks with little permanent distortion
 - (c) can cut another metal
 - (d) can be rolled or hammered into thin sheets.
- (iii) Factor of safety in case of a ductile material is a ratio of :
- (a) real stress / unit stress
 - (b) ultimate stress / maximum stress
 - (c) yield stress / allowable stress
 - (d) none of the above.
- (iv) Maximum principal stress theory is applicable for :
- (a) Ductile materials
 - (b) Brittle materials
 - (c) Elastic materials
 - (d) All of the above.

- (v) Stress concentration in a member is caused due to :
- (a) variation in property of material from point to point
 - (b) pitting at points or areas at which load is applied
 - (c) abrupt change in section
 - (d) all of the above.
- (vi) If a material fails below its yield point, failure would be due to :
- (a) straining
 - (b) fatigue
 - (c) creep
 - (d) impact loading.
- (vii) Belt slip may occur due to :
- (a) heavy load
 - (b) loose belt
 - (c) driving pulley too small
 - (d) all of the above.

(viii) The gears are used to connect two parallel shafts except :

- (a) Spur gear
- (b) Helical gear
- (c) Double helical gears
- (d) Bevel gears.

(ix) A screw jack used for lifting the loads is :

- (a) a reversible machine
- (b) a non-reversible machine
- (c) an ideal machine
- (d) none of these.

(x) What is the function of gudgeon pin ?

- (a) Acts as stiffeners
- (b) Supports piston head
- (c) Connects piston to connecting rod
- (d) All of the above.

2. Answer any *six* questions : $6 \times 5 = 30$

(a) What are the different factors that should be considered while selecting the materials for the component of machines ?

(b) What are the various manufacturing methods of machine parts ?

(c) Define plain carbon steel. How is it designated according to Indian Standard ?

(d) What is factor of safety ? What are the different factors that should be considered during selection of factor of safety ?

(e) What is stress concentration ? What are the methods of reducing stress concentration ?

(f) Write Soderberg's equation and state its application to different type of loadings .

(g) Explain, with the help of sketches, the various types of flat belt drives.

(h) How are gears classified and what are the terms used in spur gear terminology ?

3. Answer any *four* questions $4 \times 15 = 60$

(a) The load on a bolt consists of an axial pull of 10 kN together with a transverse shear force of 5 kN. Find the diameter of the bolt required according to :

(i) Maximum principal stress theory

(ii) Maximum shear stress theory

(iii) Maximum distortion energy theory.

Take permissible tensile stress at elastic limit as 100 MPa.

- (b) A simply supported beam has a concentrated load at the centre which fluctuates from a value of P to $4P$. The span of the beam is 500 mm and its cross-section is circular with a diameter of 60 mm. The material of the beam has an ultimate stress of 700 MPa, a yield stress of 500 MPa, endurance limit of 330 MPa for reversed bending. Assume a factor of safety of 1.3, size factor of 0.85 and a surface finish factor of 0.9.

Calculate the maximum value of P using :

- (i) Soderberg relation and
 - (ii) Goodman relation.
- (c) A belt drive is to transmit 110 kW with 20% overload by a system of two parallel pulleys of diameter 0.9 m and 1.2 m, centre-to-centre distance of 3.6 m, a belt speed of 20 m/s, coefficient of friction 0.3, a slip of 1.2% at each pulley and 5% friction loss at each shaft. The safe stress for the belt is 2.5 MPa and its density is 1000 kg/m^3 . Assume ratio of belt thickness to belt width as 1:25.

Find :

- (i) thickness of belt
- (ii) width of belt and
- (iii) length of belt.

- (d) A pair spur gears having 20° full depth involute teeth is to transmit 20kW, when the pinion rotates at 300 rpm. The velocity ratio is 1:3. The allowable static stresses for the pinion and gear materials are 120 MPa and 100 MPa respectively. The pinion has 15 teeth and its face width is 14 times the module.

Determine :

- (i) module
 - (ii) face width
 - (iii) pitch circle diameter of both the pinion and gear from the standpoint of strength.
- (e) A screw of a screw jack having double start threads of 25mm nominal diameter and 5 mm pitch is acted upon by an axial load of 10 kN. The outer and inner diameters of screw collar are 50 mm and 20 mm respectively. The coefficient of the thread friction and collar friction may be assumed as 0.2 and 0.15 respectively. The screw rotates at 12 rpm. Assuming uniform wear condition at the collar and allowable thread bearing pressure of 5.8 N/mm^2 .

Find :

- (i) the torque required to rotate the screw;
 - (ii) the stress in the screw; and
 - (iii) the number of threads of nut in engagement with screw.
- (f) Determine the dimensions of an I-section connecting rod for an IC engine running at 1800 rpm and developing a maximum pressure of 3.15 N/mm^2 . The diameter of the piston is 100 mm ; mass of reciprocating parts per cylinder 2.25 kg.; length of connecting rod from centre-to-centre 380 mm ; stroke of piston 190 mm and compression ratio 6:1. Take compressive yield stress 320 N/mm^2 ; constant $a = 1/7500$ and factor of safety of 6.