Total No. of printed pages = 6

ME 131604

Roll No. of candidate | | | | | | | | | | |

2016

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.

I. Fill in the blanks : (any *five*) 5×2=10

(a) A machine is designed to perform specific functions with maximum ——— and ———.

(b) Modulus of elasticity is the ratio of ——— to ———.

(c) 55C4 indicates a plain steel with ——— % carbon and ——— % manganese.

(d) A standard specimen that can sustain unlimited number of cycles without ——— failure is the ——— limit of the material.

[Turn over

(e) The two popular forms of thread used in power screws are ——— and ———.

(f) Example of flexible drive is ——— drive and that of rigid drive is ——— drive.

(g) A connecting rod is a link between the ——— and the ———.

2. Answer any *five* : 5×3=15

(a) Draw the typical stress-strain diagram for a ductile material and indicate the salient points.

(b) What are the broad classifications of manufacturing processes ?

(c) What are the three basic modes of failure of mechanical components ?

(d) What is stress concentration ?

(e) Draw the stress-time curve of three mathematical models of cyclic stresses.

(f) What is self-locking of power screw ?

(g) Name the standard systems for the shape of gear tooth.

3. Answer any *three* : 3×5=15

(a) What is factor of safety ? Why is it necessary to maintain factor of safety ? 2+3=5

(b) State the criteria of failure for :

(i) maximum principal stress theory and

(ii) maximum shear stress theory. 2.5+2.5=5

(c) What is cumulative damage in fatigue ? State the Miner's equation. 3+2=5

(d) Draw the fatigue diagram (stress amplitude-mean stress diagram) for a component subjected to fluctuating stresses indicating the different lines. 5

(e) Show the terminology of a spur gear with a neat diagram. 5

4. Answer any *four* questions : 4×15=60

(a) A shaft made of steel with yield strength 700 MPa is subjected to loads consisting of bending moment 10 kN-m and a torsional moment 30 kN-m. Determine the diameter of the shaft using

(i) maximum shear stress theory

(ii) maximum principal stress theory and

(iii) maximum distortion energy theory.

Assume a factor of safety of 2.

5+5+5=15

(b) A machine component is subjected to fluctuating stress from –40 N/mm² to 100 N/mm². The corrected endurance limit stress for the machine component is 290 N/mm². The ultimate tensile strength and yield strength of the material is 580 N/mm² and 430 N/mm² respectively. Find the factor of safety using

(i) Gerber theory

(ii) Soderberg line and

(iii) Goodman line. 5+5+5=15

(c) A screw jack is to lift a load of 80 kN. The coefficient of friction between screw and nut is 0.15. The elastic strength of screw material in tension and compression is 200 MPa and in shear 120 MPa respectively. The shear stress in the nut should not exceed 80 MPa. The bearing pressure between the nut and the screw should not exceed 18 N /mm². Design the screw and nut. If an additional torque of 200 kN-mm is required to rotate the nut, what will be the efficiency of the screw jack ?

6+6+3=15

(d) Two shafts whose centres are 1m apart are connected by a V-belt drive. The driving pulley has an effective diameter of 300 mm and is supplied with 20 kW power at 1440 r.p.m. The driven pulley runs at 480 r.p.m. The angle of groove on the pulleys is 40°. Permissible tension in 236.6 mm² cross-sectional area of belt is 850 N. The material of the belt has density of 970 kg/m³ . The coefficient of friction between belt and pulley rim is 0.2. Determine, taking centrifugal tension into consideration, the number of belts required and the length of each belt. 10+5=15

(e) It is required to design a pair of gears with 20° full-depth involute teeth. The pinion shaft is connected to a 10 kW, 1440 r.p.m 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 with ultimate tensile strength of 600 N/mm². The factor of safety can be taken as 1.5. Design the gears. 15

(f) Determine the dimensions of cross-section of the connecting rod for a diesel engine with following data :

Cylinder bore = 100 mm ;

Length of connecting rod = 350 mm ;

Maximum gas pressure = 4 MPa ;

Factor of safety = 6.