CBCS SCHEME

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18MT52

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
Design and Analysis of Machine Elements

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define machine design and explain briefly the six steps involved in the design procedure. **(08 Marks)**

b. Design standardization and state the standards used in machine design. **(06 Marks)**

c. Define stress concentration and what are the methods of reducing stress counteraction. **(06 Marks)**

OR

2 a. Explain the following theories of failure.
i) Maximum normal stress theory
ii) Maximum shear stress theory. **(10 Marks)**

b. A machine element is loaded so that σ_1 = 120MPa, σ_2 = 0MPa and σ_3 = –90MPa, the material has a yield strength in tension and compression of 360MPa, find the factor of safety for each of the following failure theories.
i) Maximum normal stress theory
ii) Maximum shear stress theory
iii) Distortion energy theory. **(10 Marks)**

Module-2

3 a. Define endurance limit and mention the factors affecting endurance limit. **(08 Marks)**

b. Derive Goodman criterion for fatigue strength under fluctuating stresses. **(12 Marks)**

OR

4 Around rod of diameter 1.2d is reduced to a diameter (d) with a fillet radius of 0.1d. This stepped rod is to sustain a twisting moment that fluctuates between +2.5kN.m and 1.5kN.m together with a bending moment that fluctuates between +1kNm and –1kNm. The rod is made of carbon steel C40 (σ_y = 328.6MPa, σ_u = 620MPa). Determine a suitable value for "d". **(20 Marks)**

Module-3

5 a. Derive an expression for torque required to raise the load on squared threaded screw. **(08 Marks)**

b. Explain self locking and overhauling in power screws. **(04 Marks)**

c. A square threaded power screw has the specification of 80 × 16, with a double start is to raise a load of 100kN. The mean collar diameter is 130mm. The coefficient of friction for the threads and the collar are respectively 0.1 and 0.12. Determine :
i) Torque required to rise the load
ii) Efficiency of the screw
iii) Whether self locking exists. **(08 Marks)**

OR

6 a. Derive an expression for the shear stress induced in a helical compression spring, with usual notations. **(08 Marks)**

b. A helical valve spring is to be designed for an operating load range of approximately 90 to 135N. The deflection of the spring for the load range is 7.5mm. Assume a spring index of 10 and factor safety = 2. Design the spring. **(12 Marks)**

Module-4

7 Design a bronze spur gear $81.4 N/mm^2$ and mild steel pinion of $101 N/mm^2$ to transmit 5kW at 1800rpm. The velocity ratio is 3 : 5 : 1. Pressure angle is $14\frac{1}{2}$. Not less than 15 teeth are to be used on either gear. Determine the module and face width. Also suggest suitable surface hardness for the weaker member based on dynamic and were considerations. **(20 Marks)**

OR

8 Design a pair of helical gears to transmit a power of 20kW from a shaft running at 1500rpm to a parallel shaft to be run at 450rpm. Suggest suitable surface hardness for the gear pair. **(20 Marks)**

Module-5

9 a. Design finite element method and explain the basic steps in finite element method. **(14 Marks)**

b. Write a short note on :
i) Size of the element
ii) Number of element
iii) Location of nodes. **(06 Marks)**

OR

10 For the axially loaded bar shown in Fig.Q10. Determine :
i) Nodal displacement
ii) Element stresses
iii) Support reactions.
Take E_{steel} = 200GPa and E_{cu} = 100GPa.

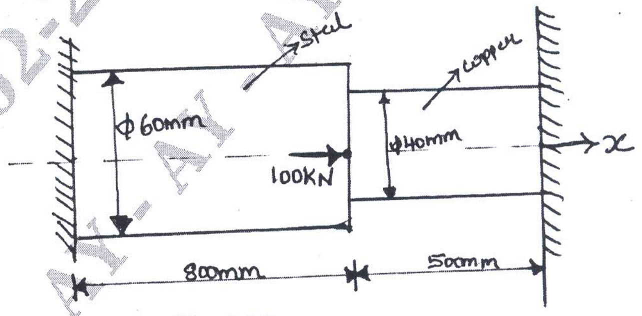

Fig.Q10 **(20 Marks)**

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