

# CBCS SCHEME

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15MA54

## Fifth Semester B.E. Degree Examination, June/July 2018 Elements of Machine Design

Time: 3 hrs.

Max. Marks: 80

- Note: 1. Answer any FIVE full questions, choosing one full question from each module.  
2. Machine Design Data hand book is permitted.

### Module-1

- Write brief note on general procedure used in design. (06 Marks)
  - Explain the theories of failure. (06 Marks)
  - Define factor of safety and discuss factors influencing selection of appropriate value for the factor of safety. (04 Marks)

OR

- Explain mechanical properties (any 6) of materials. (08 Marks)
  - A circular rod of 60mm diameter is subjected to loads as shown in Fig Q2(b). Determine the nature and magnitude of stresses at the critical points. (08 Marks)

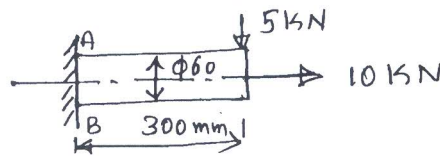


Fig Q2(b)

(08 Marks)

### Module-2

- Derive the equation for Soderberg's criterion. (06 Marks)
  - A cantilever beam made of cold drawn carbon steel  $\sigma_u = 550\text{MPa}$ ,  $\sigma_y = 470\text{MPa}$ ,  $\sigma_{-1} = 275\text{MPa}$  of circular cross section is subjected to load which varies from  $-F$  to  $3F$ . Determine the maximum load that this member can withstand for an infinite life using a factor of safety of 2. (08 Marks)

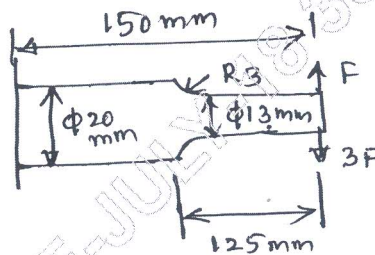


Fig Q3(b)

(10 Marks)

OR

- A shaft is mounted between bearings located 9.5m apart and transmits 10,000 kW at 90rpm. The shaft weight 66,000N, has outside diameter = 450mm and inner diameter = 300mm. Determine the stress induced in the shaft and the angular deflection between the bearing. Do not neglect the weight of the shaft. (08 Marks)
  - A hollow shaft 500mm outside diameter and 300mm inside diameter is used to drive a propeller of a marine vessel. The shaft is mounted on bearing 6m apart and transmits 60,000kW at 150rpm. The maximum axial propeller thrust is 500kN and the shaft weights 70kN.  $G = 84\text{GPa}$ . Determine :
    - Max shear stress developed in the shaft
    - Angular twist between the bearings. (08 Marks)

**Module-3**

- 5 A spur gear drive is required to transmit 100kW at a velocity ratio of 4. The gear material may be taken from any medium carbon steel with a hardness of 300BHN. The speed of the pinion is limited to 950 rpm. The sum of the maximum number of teeth of gear and pinion should not be less than 400. Design the gear set for satisfactory operation under all loading condition. The factor of safety may be taken as 1.5. (16 Marks)

**OR**

- 6 Design a straight bevel gear for two shafts intersects perpendicularly to deliver 5kW at 900rpm with a gear ration of 3:1. The pressure angle of the gear is  $20^\circ$ . The pinion has 20 teeth. The gear set is operated under uniform loading condition. Taking a design factor of 2, design the gear. The bending stress of gear material is 205 MPa and contact stress is 1380 MPa. The bending endurance strength may be taken 690MPa. (16 Marks)

**Module-4**

- 7 Design a knuckle joint to sustain a tensile load of 90kN. The allowable stresses for rods and pin are 90MPa in tension, 60MPa in shear and 150MPa in crushing. (16 Marks)

**OR**

- 8 Design a C.I flange coupling to transmit 15kW at 1200 rpm. The allowable shear stress for C.I flange is 3MPa and for shaft, keys and bolts is 75MPa. The allowable bearing stress for key is 150MPa. (16 Marks)

**Module-5**

- 9 a. Derive Petroff's equation for a lightly loaded bearing. (04 Marks)  
b. A bearing for an axial flow compressor is to carry a radial load of 4905 N and thrust load of 2452 N. The service imposes light shock and the bearing is used for 40hr/week for 5 years. The speed of shaft is 300rpm and diameter of shaft is 60mm. select as suitable bearing. (12 Marks)

**OR**

- 10 a. Explain the properties (any 6) of lubricants. (06 Marks)  
b. A full journal bearing 200mm diameter and 200mm long is to support a radial load of 45kN at an operating speed of 960rpm. If it is to be operated at a Sommerfield number of 0.08 when the radial clearance is 0.2mm, determine the viscosities of oil to be used. Estimate also the power loss in the bearing if the resulting coefficient of friction value is 0.00315. Sommerfield number is determined with speed in rps. (10 Marks)

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