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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Third Semester, M.Tech. - Mechanical Engineering (MMDN)

Semester End Examination; Dec. - 2019

Design and Analysis of Machine Components

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **TWO** full questions from **UNIT - I** and any **ONE** full question from **UNIT - II**.*
ii) Any missing data may be assumed. iii) Use of data hand book is permitted.

UNIT - I

1. Design a cone clutch components to transmit 7.5 kW at 900 rpm. The face angle is 12.5°. The cone face is lined with leather and the normal pressure between contacting faces is not to exceed 0.9 MN/m^2 and coefficient of friction is 0.2. Determine the main dimensions of the clutch and show all the dimensions with a proportionate sketch. Find the axial force required to engage the clutch, and design the helical spring required to engage the clutch. Select material for shaft as C40 steel (σ_y = 328.6 MPa) and FOS 2.5. Assume mean diameter to face width ratio as 6. Take τ = 300 MPa and G = 81 GPa for spring material and assume maximum deflection of the spring as 60 mm. 25

2. A C-clamp is subjected to a clamping force of 4 kN maximum distance between screw axis and inner edge of frame is 150 mm and maximum distance between jaws are 270 mm. Design the screw by selecting C-30 steel of (σ_y = 300 N/mm^2) and (σ_u = 550 N/mm^2) and Factor of safety as 4 based on σ_y value. Limiting bearing pressure between the screw and the nut is 7.845 N/mm^2. Assuming that maximum effort likely to be exerted at the end of the handle is 300 N. The handle is made of C-40 steel of (σ_y = 300 N/mm^2) and take factor of safety as 2. The frame martial having (σ_{ut} = 258 N/mm^2) and take factor of safely as 5. Determine the following dimensions and show the arrangement by means of a neat sketch; 25

   i) Screw and nut dimensions assume friction angle ϕ = 6°
   ii) Frame of I-section having dimensions height of section = 10 *t* and width of section = 6 *t*, where *t* = thickness of flange and web
   iii) Design the handle

3. A punching machine makes 25 working strokes per minute and is capable of punching 25 mm dia. holes is 18 mm thick. Steel plates having an ultimate shear strength 300 MPa. The punching operations take place during 1/10th of a revolution of the crank shaft.

   Estimate the power needed for the driving motor, assuming a mechanical efficiency of 95%. Determine suitable dimension for the rim cross section of the fly wheel, having width equal to twice thickness. The fly wheel is to revolve at 9 times the speed of the crank shaft. 25

   The flywheel is to be made of cast iron having a working stress of 6 MPa, and density of 7250 kg/m^3. The diameter of the flywheel must-not exceeds 1.4 m owing to space restrictions. The hub and the spokes may be assumed to provide 5% of the rotational inertia of the flywheel.

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UNIT - II

4. Design a C.I. piston for a single acting four stroke engine for the following data :
   Cylinder bore = 100 mm; Stroke = 125 mm; Max gas pressure = 5 N/mm^2; Indicated mean effective pressure = 0.75 N/mm^2; Mechanical efficiency = 80%; Fuel-consumption = 0.15 kg per brake power per hour; Higher calorific value of fuel = 42×10^3 kJ/kg; Speed = 2000 rpm. Any other data required for the design may be assumed. Take difference of temperature at the centre and at the edge of the piston as 220°C and heat conductivity of cast iron is 46.6 W/m°C. Show major dimensions with proportionate sketch. 50

5. Design a connecting rod for an I.C engine running at 1800 rpm and developing a maximum pressure of 315 N/mm^2. The diameter of piston is 100 mm; mass of reciprocating parts per cylinder 2.25 kg; length of connecting rod 380 mm; stroke of piston 190 mm and compression ratio 6:1. Take a FOS of 6 for the design. Take length to diameter ratio for big end bearing as 1.3 and small end bearing as 2 and the corresponding bearing pressure as 10 N/mm^2 and 15 N/mm^2. The density of material of the rod may be taken as 8000 kg/m^3 and the allowable stress in the bolts as 60 N/mm^2 and in cap as 80 N/mm^2. The rod is to be of I-section for which height of the section is $5t$ and width of section is $4t$. Where t is the thickness of the web and the flange. 50
   Draw the neat sketch with major dimensions.

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