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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; Jan / Feb - 2021

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 to transmit 30 kW of power at 1200 r.p.m. Assume a shear stress of 42 MPa. 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 — 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 material having (σ_{ult} = 258 N/mm^2) and take factor of safety 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 $\phi = 6°$.
   ii) Frame of I-section having dimensions, height of section = 10t and width of section = 6t, 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 dimensions for the rim cross section of the flywheel, having width equal to twice thickness. The flywheel is to revolve at 9 times the speed of the crank shaft.
   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 exceed 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. — 25

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UNIT - II

4. A C.I. trunk type of piston for a four stroke, single cylinder, semi diesel engine running at 750 r.p.m is to be designed. The maximum explosion pressure on the cylinder head is to be near about 35 kgf/cm^2. The mean effective pressure is about 6.5 kgf/cm^2. The fuel consumption is 0.225 kg per metric H.P per hour. Diameter and stroke of the piston is 20 cm and 25 cm respectively. The connecting rod, the piston is to have at least 3 sealing rings and 2 oil rings. Permissible pressure of the rings should be between 0.35 to 0.42 kgf/cm^2. Permissible bending stress for the piston ring material is to be about 800 kgf/cm^2. Heat conductivity of C.I. is about 63 to 71 calories per cm^2 per centimeter length per hour per degree centigrade. Temperature at the center and at the edges of the piston face may be assumed approximately 320 to 150°C respectively. Show major dimensions with proportionate sketch. 50

5. A connecting rod is to be designed for an I.C engine running at 1800 r.p.m 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 bearings as 1.3 and small end bearings 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 flange. Draw the neat sketch with major dimensions. 50

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