SV-94

Total No. of Pages : 4

Seat No.	

B.E. (Mechanical) (Semester - VII) (New) Examination, April - 2018
MECHANICAL SYSTEM DESIGN
Sub. Code : 67502

Day and Date : Wednesday, 25 - 04 - 2018 **Total Marks : 100**
Time : 2.30 p.m. to 5.30 p.m.

Instructions : 1) **All questions are compulsory.**
2) **Assume suitable data wherever necessary and state it clearly.**
3) **Draw neat labeled sketches wherever necessary.**

Q1) a) With suitable example, explain effect of symmetry and balance, surface finish, colour and harmony in aesthetic design. **[8]**

b) Explain importance of ergonomic considerations in the design of displays and controls in the dashboard of a car. **[8]**

OR

With suitable example explain the creativity concept in the product design.**[8]**

Q2) a) Explain with neat sketch various types of stresses acting in thin pressure vessels subjected to internal pressure. **[6]**

OR

Explain the different types of end closures used in pressure vessels as per IS 2825 - 1969. **[6]**

b) A cylindrical pressure vessel shell of inside diameter 1500 mm is subjected to an internal pressure of 2 MPa. The shell as well as heads are made of low alloy steel with an ultimate tensile strength of 450 N/mm^2. The double welded butt joints which are spot radiographed ($\eta = 0.85$), are used to fabricate the vessel. The corrosion allowance is 3 mm. Determine the thickness of the cylindrical shell and the thickness of the head if the heads are: **[12]**

i) Flat Head;

ii) Plain Formed;

iii) Hemispherical;

iv) Toro spherical with crown radius of 1125 mm;

P.T.O.

Q3) a) What is braking torque? Discuss various energy equations used in the design of Brakes. **[8]**

b) A multi-disk plate clutch consists of five steel plates and four bronze plates. The inner and outer diameters of the friction disks are 75 and 150 mm respectively. The coefficient of friction is 0.1 and the intensity of pressure on friction lining is limited to 0.3 N/mm^2. Assuming uniform wear theory, calculate: **[8]**

i) Required force to engage the clutch and

ii) Power transmitting capacity at 750 rpm.

OR

A four wheeled automobile car has a total mass of 1000 kg. The moment of inertia of each wheel about a transverse axis through its center of gravity is 0.5 kg-m^2. The rolling radius of the wheel is 0.35 m. The rotating and reciprocating parts of the engine and the transmission system are equivalent to a moment of inertia of 2.5 kg-m^2, which rotates at five times the road - wheel speed. The car is travelling at a speed of 100 km/h on a plane road. When the brakes are applied the car decelerates at 0.5g. There are brakes on all four wheels. Calculate: **[8]**

i) The energy absorbed by each brake.

ii) The torque capacity of each brake.

Q4) a) Explain the optimization of structural diagram in the design of a multi speed machine tool gear box. **[6]**

OR

Explain the advantages of geometrical progression for selecting the speed steps of a multi speed machine tool gear box. **[6]**

b) A three-stage, twelve speed gear box is to be designed for multi spindle speeds varying between 60 r.p.m. and 2880 r.p.m. The second stage consists three speed steps, if the gear box is driven by 5 kW, 1440 r.p.m. electric motor. Assume same module for all gears. **[12]**

i) Draw the speed ray diagram.

ii) Draw the gearing diagram.

iii) Determine the number of teeth on gears.

Q5) a) Explain step by step procedure for finding out the dimensions of the I-sections of the connecting rod. [8]

b) Determine the small and the big end bearings of the connecting rod for a diesel engine with the following data: [8]

i) Cylinder Bore = 80 mm

ii) Maximum gas pressure = 3 MPa

(l/d) ratio for piston pin bearings = 2

(l/d) ratio for crank pin bearing = 1.2

Allowable bearing pressure for piston pin bearing = 10 MPa

Allowable bearing pressure for crank pin bearing = 06 MPa

OR

The following data is given for a connecting rod:

Engine speed = 1500 rpm.

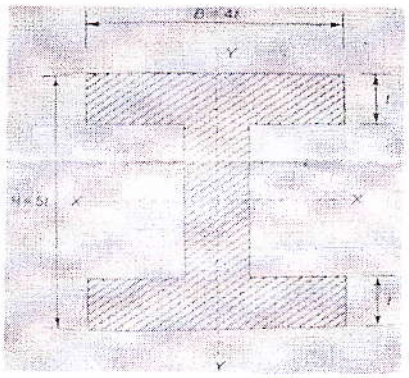
Length of connecting rod = 250 mm.

Length of stroke = 150 mm.

Density of material = 7800 kg/m^3

Thickness of web or flanges = 6 mm

Assume the cross-section of the connecting rod as shown in figure for which Area of cross section. Calculate the whipping stress in the connecting rod.



(A) $= 11t^2$, $I_{xx} = \left(\frac{419}{12}\right)t^4$ and $y = \left(\frac{5t}{2}\right)$. [8]

Q6) a) Explain Lagrange's Multiplier method for optimum design. **[8]**

OR

Explain the following terms in Johnson method of optimization. **[8]**

i) Primary Design Equation (PDE)

ii) Subsidiary Design Equation (SDE)

iii) Limit Equation (LE)

b) A shaft is to be used to transmit a torque of 1500 N-m. The required torsional stiffness of the shaft is 100 N-m/degree, while the factor of safety based on yield strength in shear is 2.0. Using the maximum shear stress theory, design the shaft with the objective of minimizing the weight, out of the following materials: **[8]**

Use following data for the materials.

Material	Weight Density (w) N/m^3	Yield Strength (S_{yt}) MPa	Modulus of rigidity (G) N/mm^2
Chromium steel	77×10^3	420	84×10^3
Plain carbon steel	76.5×10^3	230	84×10^3
Titanium Alloy	44×10^3	900	42×10^3
Magnesium Alloy	17.5×10^3	225	15×10^3