Seat No.	

B.E. (Mechanical) (Semester - VII) (New Course) Examination, May - 2017
MECHANICAL SYSTEM DESIGN
Sub. Code : 67502

Day and Date : Tuesday, 16 - 05 - 2017 **Total Marks : 100**
Time : 2.00 p.m. to 5.00 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) What is aesthetics? Explain with suitable example the role of various features in the aesthetic design considerations. **[8]**

b) Explain with neat sketches ergonomic design consideration in design of ladies bicycle. **[8]**

OR

Explain the design considerations in controls and displays. **[8]**

Q2) a) Derive Birnie's equation to determine the thickness of thick pressure vessel. **[8]**

OR

Explain with neat sketches the supports used in pressure vessels. **[8]**

b) A high pressure cylinder consists of an inner cylinder of inner and outer diameter of 200mm and 300mm respectively. It is jacketed by an outer cylinder with an outside diameter of 400 mm. The difference between the outer diameter of the inner cylinder and the inner diameter of the jacket before assembly is 0.25mm ($E = 207$ kN/mm^2). Calculate the shrinkage pressure and the maximum tensile stress induced in any of the cylinders. **[10]**

P.T.O.

Q3) a) Derive the torque transmitting capacity of single plate clutch using uniform pressure theory. **[8]**

b) A four wheeled automobile car has a total mass of 1000kg. 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 0.35m. 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 100km/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.

OR

A centrifugal clutch consists of four shoes, each having a mass of 1.5 kg. In the engaged position, the radius to the center of gravity of each shoe is 110 mm, while the inner radius the drum is 140mm. The coefficient of friction is 0.3. The pre-load in the spring is adjusted in such a way that the spring force at the beginning of engagement is 700 N. The running speed is 1440 rpm. **[8]**

Calculate:

i) The speed at which the engagement begins;

ii) The power transmitted by the clutch at 1440 rpm.

Q4) a) Difference between structural diagram and Speed diagram. **[6]**

OR

Explain briefly need of speed deviation diagram in the design of multi speed machine tool gear box. **[6]**

b) A multi speed gear box, determine the speed steps arranged in geometric progression for the following conditions: n_{min} = 100 r.p.m, n_{max} = 1800 r.p.m. and z = 9. If the gear box is driven by 5kW, 1440 r.p.m. electric motor: **[12]**

i) Draw the speed ray diagram.

ii) Draw the gearing diagram.

iii) Determine the number of teeth on gears.

Assume same module for all gears.

Q5) a) Explain design of studs for cylinder head. **[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 = 80mm

ii) Maximum gas pressure = 3Mpa

(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

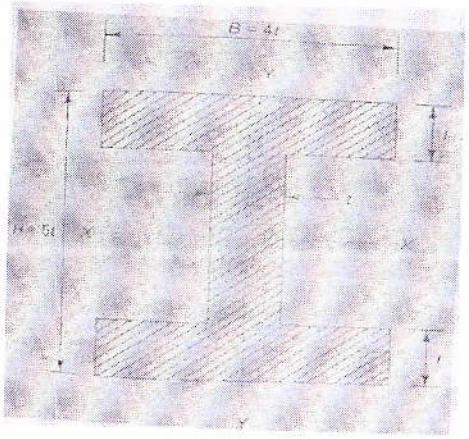
Length of connecting rod = 250 mm.

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 Johnson method of optimum design. [8]

OR

Explain briefly following terms,

i) Functional parameters group.

ii) Material parameters group.

iii) Geometrical parameters group.

in the design of mechanical elements. [8]

b) A shaft is to be used to transmit a torque of 1500 N-m. The required torsional stiffness of the shaft is 100N-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.

Use following data for the materials [8]

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