



Answer all the following questions

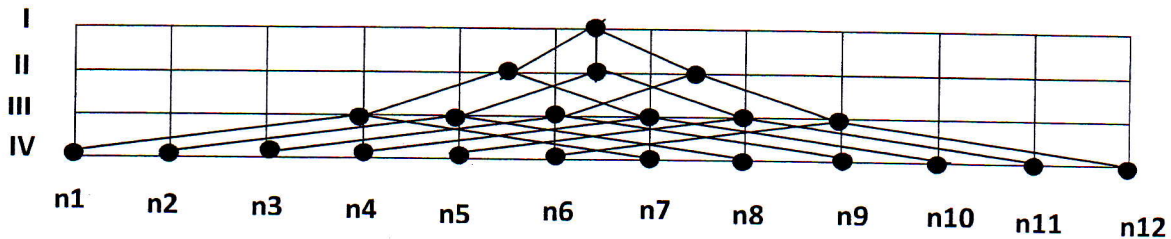
Assume any missed data

Q₁ (60 Marks):

An electric motor 5 Kw/ 1200 r.p.m. attached to a gearbox to drive a turning machine, the gear box has the following specifications:

- . No. of the carried out speeds = 12 speed
- . $n_1 = 1000$ r.p.m., $n_{12} = 80$

According to the following flow chart :



a) Draw: (10 Marks)

- The kinematic diagram,

- The speed chart.

b) Design: (3X10=30 Marks)

- The belt and pulleys arrangement,
- The second shaft.

- The gears, and

c) Select: (10 Marks)

- The suitable bearings for each shaft.

d) Explain: (10 Marks)

- The procedure of selecting the suitable anti-friction bearing in machine tools gear boxes.

Q₂ (20Marks) :

A lathe has a V and flat combination guide-way.

Assuming:

- The center distance between the guide ways is 560 mm,
- The height of the spindle center above the flat guide guideway = 150 mm,
- The lathe is subjected to a 160 kg vertical force (F_z), and a 50 kg horizontal force (F_y), at the cutting point on the 200 mm diameter,
- Saddle weight = 35 Kg and its length = 100 mm,
- $\alpha = 60^\circ$ & $\beta = 30^\circ$,
- The material is cast iron to cast iron slide ways with recommended pressure 0.125 kg/mm^2 , and
- The height of V slide way is 10.

Calculate:

- The average pressure acting on each contact face, and show if it is safe or not.

Q₃ (8X5 = 40 Marks)

With the aide of net sketches discuss the following:

- a) Open and closed guideways in case of sliding and anti-friction types,
- b) The type of slideways suitable for:
 - * Orthogonal cutting, and
 - * Oblique cutting.
- c) Axial play occurs on components of both types; sliding and anti-friction power screws, and how to avoid it.
- d) The factors controlling good spindle unit design and forces acting on that unit in center lathes.
- e) The positive and negative effects of friction in the field of mechanical design.
- f) Stick- slip phenomena and how to eliminate it.
- g) The different types of antifriction bearings from the point of view of geometry, intermediate elements, load carrying capacity, and loading type.
- h) Anti-friction guideways ; shape, advantages, and disadvantages.

Q₄ (20 Marks):

A semi-circular profile ball – recirculating power screw – and – nut assembly has a screw diameter = 60 mm, ball diameter = 8 mm and total number of balls =150. Both the screw and nut are made of steel. Determine the load on a single ball and the maximum pulling forces under static and dynamic loading. The screw rotates at an average of 40 rpm and must have a guaranteed service life of 10 000 h before the balls can be changed.

Best Wishes

This exam measures the following ILOs			
Question Number	Q1-c, Q1-d, Q3-c, Q3-d, Q3-g, & Q3-h	Q1-b, Q2 , Q3-e, Q3-f & Q4	Q 1-a , Q3-a, Q3-b
Skills	a4-1 , a13-1, a13-2 ,a13-3, a13-4& a19-1	b2-1,b2-2, b17-1	c7-1, c14-1
	Knowledg & understanding skills	Intellectual Skills	Professional Skills