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- ix) The product of circular pitch and diametral pitch is equal to
- a) module
 - b) unity
 - c) π
 - d) $\frac{1}{\pi}$.
- x) Static balancing involves balancing of
- a) masses
 - b) forces
 - c) couples
 - d) forces as well as couples.

GROUP – B
(Short Answer Type Questions)

Answer any *three* of the following. $3 \times 5 = 15$

2. Describe with neat sketch the arrangement of atoms in the B.C.C., F.C.C and H.C.P. lattices. Show that an F.C.C. structure is always more close packed than the B.C.C. structure.
3. Distinguish between plastic deformation and fracture.
4. Deduce expressions for the velocity and acceleration of the follower in a cam-follower mechanism when it moves with simple harmonic motion.



5. Two spiral gears have a normal module of 12 mm and angle between the shaft axes is 60° . The driver has 16 teeth and a helix angle of 25° . If the velocity ratio is 0.5 and the driver and the follower both are left handed, find the centre distance between the shafts.
6. Write the expression for the ratio of shaft velocities for Hooke's joint. From this expression determine the condition for equal speed of the driving and driven shafts.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

7. a) Explain the phenomenon of 'fatigue in metals'. Discuss the effect of
- i) surface residual stress and
 - ii) stress concentration on fatigue strength of metal.
- b) Calculate the atomic packing factor for copper.
- c) What is meant by the term 'critical cooling rate' as applied to steel ? Describe with the aid of diagrams , the structural change which may take place when plain carbon steel is cooled from the austenite state. How are these changes dependent upon the rate of cooling.

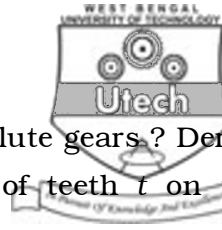
$7 + 2 + 6$



8. a) Draw a typical 'creep test' curve showing different stages of elongation for a long time high temperature creep test. State how the information is helpful to the design.
- b) Name the different annealing processes. Is spheroidising different from annealing ? Explain.
- c) Distinguish between hardness and hardenability.
9. a) What is creep in a belt drive ? What is its effect on velocity ratio in a belt drive ?
- b) The power transmitted between two shafts 3.5 m apart by a cross belt drive round the two pulleys 600 mm and 300 mm in diameters, is 6 kW. The speed of the larger pulley (driver) is 220 r.p.m. The permissible load on the belt is 25 N/mm width of the belt which is 5 mm thick. The coefficient of friction between the smaller pulley surface and the belt is 0.35. Determine
- the necessary length of the belt
 - the width of the belt and
 - the necessary initial tension in the belt.
- c) What are the advantages of V-belt drive over flat belt drive ? Write down an expression for the ratio of tight and slack side tensions in case of a V-belt drive.

$$(4 + 3) + (3 + 2) + 3$$

$$(2 + 2) + 8 + (2 + 1)$$



10. a) What is meant by interference in involute gears? Derive an equation for minimum number of teeth t on the pinion in order to avoid interference.
- b) Two gear wheels mesh externally and are to give a velocity ratio of 3. The teeth are of involute form of module 6. The standard addendum is 1 module. If the pressure angle is 18° and pinion rotates at 90 rpm, find
- the number of teeth on each wheel, so that the interference is just avoided
 - the length of the path of contact, and
 - the maximum velocity of sliding between the teeth.
- (2 + 6) + 7
11. a) Define the terms 'coefficient of fluctuation of energy' and 'coefficient of fluctuation of speed'.
- b) The turning moment curve for an engine is represented by the equation,
- $$T = 20000 + 9500 \sin 2\theta - 5700 \cos 2\theta \text{ N-m, where } \theta \text{ is the angle moved by the crank from inner dead centre. If the resisting torque is constant, find :}$$
- power developed by the engine;
 - moment of inertia of flywheel in kg-m^2 , if the fluctuation of speed is not to exceed 1% of mean speed which is 180 r.p.m.
- c) Explain the analytical method of balancing of different masses revolving in the same plane.
- 4 + 6 + 5



12. a) A single dry plate clutch transmits 8.5 kW at 900 r.p.m. The axial pressure is limited to 0.07 N/mm^2 . If the coefficient of friction is 0.25, find
- i) mean radius and face width of the friction lining assuming the ratio of the mean radius to the face width as 4, and
 - ii) outer and inner radii of the clutch plate.
- b) What do you mean by gyroscopic couple ? Derive an expression for its magnitude.
- c) Explain the term 'pitching' of a naval ship.

$$7 + (2 + 4) + 2$$

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