

# C. U. SHAH UNIVERSITY

## Winter Examination-2021

Subject Name: Machine Design-II

Subject Code: 4TE07MDE1

Branch: B.Tech (Mechanical)

Semester: 7

Date: 15/12/2021

Time: 02:30 To 05:30

Marks: 70

Instructions:

- (1) Use of Programmable calculator & any other electronic instrument is prohibited.
  - (2) Instructions written on main answer book are strictly to be obeyed.
  - (3) Draw neat diagrams and figures (if necessary) at right places.
  - (4) Assume suitable data if needed.
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Q-1

Attempt the following questions:

(14)

- (a) A spur gear with pitch circle diameter  $D$  has number of teeth  $T$ . The module  $m$  is defined as  
(a)  $m = d/T$     (b)  $m = T/D$     (c)  $m = \pi D/T$     (d)  $m = D.T$
- (b) In helical gears, the distance between similar faces of adjacent teeth along a helix on the pitch cylinders normal to the teeth, is called  
(a) normal pitch    (b) axial pitch    (c) diametral pitch    (d) module
- (c) The root angle of a bevel gear is equal to  
(a) pitch angle – addendum angle    (b) pitch angle + addendum angle  
(c) pitch angle – dedendum angle    (d) pitch angle + dedendum angle
- (d) In worm gears, the angle between the tangent to the thread helix on the pitch cylinder and the plane normal to the axis of worm is called  
(a) pressure angle    (b) lead angle    (c) helix angle    (d) friction angle
- (e) If the number of stages in a gearbox is 'n', how many vertical lines will be drawn at a convenient distance in a speed diagram?  
(a)  $n-1$     (b)  $n$     (c)  $n+1$     (d)  $n+2$
- (f) The sum of the number of teeth on gear pairs for parallel shafts of the gearbox should be \_\_\_\_\_.  
(a) same    (b) varying    (c) non-integer    (d) odd number
- (g) The length of the cylinder is usually taken as  
(a) equal to the length of piston    (b) equal to the length of stroke  
(c) equal to the cylinder bore    (d) 1.5 times the length of stroke
- (h) The skirt of piston  
(a) is used to withstand the pressure of gas in the cylinder  
(b) acts as a bearing for the side thrust of the connecting rod  
(c) is used to seal the cylinder in order to prevent leakage of the gas past the piston  
(d) none of the above
- (i) The rocker arm is used to actuate the inlet and exhaust valves motion as directed by the  
(a) cam and follower    (b) crank    (c) crankshaft    (d) none of these
- (j) Principle of 'Unit load' states that



- (a) materials should be moved in lots      (b) one unit should be moved at a time  
 (c) both 'a' and 'b'      (d) none of the above
- (k)** Cranes are used for  
 (a) lifting and lowering      (b) vertical transportation  
 (c) both 'a' and 'b'      (d) none of the above
- (l)** The material commonly used for crane hooks is  
 (a) cast iron      (b) wrought iron      (c) mild steel      (d) aluminium
- (m)** Johnsons Method is the method of  
 (a) product design      (b) compound design      (c) optimum Design      (d) system design
- (n)** Ranges of certain parameters are expressed as:  
 (a) cost, weight      (b) stress equation      (c) limit equation      (d) shape, dimension

**Attempt any four questions from Q-2 to Q-8.**

**Q-2      Attempt all questions**

- (a)** What are the various forces acting on worm and worm gears? **(05)**
- (b)** Design a suitable speed gear box for a head stock of a lathe that has a variation of speed from *105 r.p.m.* to *690 r.p.m.* in 9 steps. The power is supplied by an electric motor of *10 kW* capacity, running at *1000 r.p.m.* and driving the input shaft through a V-belt drive, having speed ratio of *2: 1*. **(09)**  
 Draw the structural diagram, speed chart and determine the number of teeth on each gear.

**Q-3      Attempt all questions**

- (a)** Explain the procedure of designing multi speed gear box. **(07)**
- (b)** A pair of straight teeth spur gears is to transmit *20 kW* when the pinion rotates at *300 r.p.m.* The velocity ratio is *1: 3*. The allowable static stresses for the pinion and gear materials are *120 MPa* and *100 MPa* respectively. **(07)**  
 The pinion has *15* teeth and its face width is *14* times the module. Determine: 1. module; 2. face width; and 3. pitch circle diameters of the pinion and the gear from the standpoint of strength only, taking into consideration the effect of the dynamic loading. The tooth form factor  $y$  can be taken as

$$y = 0.154 - \frac{0.912}{\text{No. of Teeth}}$$

and the velocity factor  $C_v$  as

$$C_v = \frac{3}{3 + v}$$

where  $v$  is expressed in m/s.

**Q-4      Attempt all questions**

- (a)** What are the basic principles in selecting the type of material handling equipment? **(07)**
- (b)** A four stroke diesel engine has the following specifications : **(07)**  
 Brake power = *5 kW*; Speed = *1200 r.p.m.*;  
 Indicated mean effective pressure = *0.35 N/mm<sup>2</sup>*;  
 Mechanical efficiency = *80 %*.  
 Determine: 1. bore and length of the cylinder;  
 2. thickness of the cylinder head; and  
 3. size of studs for the cylinder head.



**Q-5**

**Attempt all questions**

- (a) Explain the design procedure connecting rod of an I.C. engine. (07)
- (b) A belt conveyor is to be designed to carry bulk material at the rate of  $300 \times 10^3$  kg/hour (07)  
with the following details:  
Bulk density of the material =  $800 \text{ kg/m}^3$   
Angle of surcharge of bulk material =  $15^\circ$   
Belt speed =  $10 \text{ km/hour}$   
Material factor for plies,  $k_1 = 2.0$   
Belt tension and arc of contact factor,  $k_2 = 63$   
No. of plies for the belt = 4.  
Suggest: (a) suitable width for the belt, (b) Diameter and length of the drive pulley.

**Q-6**

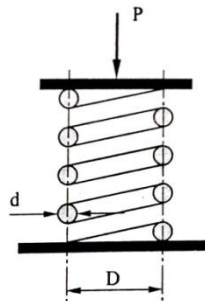
**Attempt all questions**

- (a) What is optimum design? Write down objectives and applications of optimum design. (05)
- (b) Design a cast iron piston for a single acting four stroke engine for the following data: (09)  
Cylinder bore =  $100 \text{ mm}$ ; Stroke =  $125 \text{ mm}$ ; Maximum gas pressure =  $5 \text{ N/mm}^2$ ; Indicated mean effective pressure =  $0.75 \text{ N/mm}^2$ ; Mechanical efficiency =  $80\%$ ; Fuel consumption =  $0.15 \text{ kg per brake power per hour}$ ; Higher calorific value of fuel =  $42 \times 10^3 \text{ kJ/kg}$ ; Speed =  $2000 \text{ r.p.m.}$  Any other data required for the design may be assumed.

**Q-7**

**Attempt all questions**

- (a) Explain the design procedure of Crank Hook. (07)
- (b) Prove that for a given helical spring, minimum weight for given conditions occurs (07)  
when the spring is so designed that the maximum load on it is equal to twice the initial load.



**Q-8**

**Attempt all questions**

- (a) For bevel gears, define the following : (06)  
(i) Cone distance; (ii) Pitch angle; (iii) Face angle; (iv) Root angle; (v) Back cone distance; and (vi) Crown height.
- (b) A pair of helical gears is to transmit  $15 \text{ kW}$ . The teeth are  $20^\circ$  stub in diametral plane (08)  
and have a helix angle of  $45^\circ$ . The pinion runs at  $10000 \text{ r.p.m.}$  and has  $80 \text{ mm}$  pitch diameter. The gear has  $320 \text{ mm}$  pitch diameter. If the gears are made of cast steel having allowable static strength of  $100 \text{ MPa}$ ; determine a suitable module and face width from static strength considerations and check the gears for wear, given  $\sigma_{es} = 618 \text{ MPa}$ .

