**Seat No: _____** **Enrollment No: _____**

# PARUL UNIVERSITY

## FACULTY OF ENGINEERING & TECHNOLOGY

**B.Tech. Summer-2019 Examination**

**Semester: 7** **Date: 08/05/2019**
**Subject Code: 03109401** **Time: 10:30am to 1:00pm**
**Subject Name: Machine Design-II** **Total Marks: 60**

**Instructions:**
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Make suitable assumptions or Assume data wherever necessary.
4. Design data book is **NOT** permitted.
5. Start new question on new page.

**Q.1** **Objective Type Questions** (All are compulsory) (Each of one mark) **(15)**

1. What are the different Forms of gear teeth?
2. What are two different modes of gear tooth failures generally considered in design of gears?
3. A Worm Gear pair is designated as 2/30/10/8 ,then number of teeth on worm gear is ___, number of starts on worm is ____, module is____ and diametral quotient is____.
4. Which Gear pair is used for two non intersecting shaft axes which are at 90°to each other
   (a) Rack and Pinion (b) Bevel Gear (c) Worm and Worm Gear (d) Spur gear
5. In Worm gear drive, _____ is always considered to be weaker.
   (a) Worm hub (b) Worm tooth (c) Worm Gear tooth (d) Worm gear shaft.
6. If the module of spur gear is 10 mm, then Diametral pitch ($P_d$) =_____ mm and Circular Pitch ($P_c$) =____ mm considering spur Gear.
   (a) 0.1, 10/π (b) 0.1, 10π (c) 10,10π (d) 0.1,0.1π
7. In Helical Gear ,Axial Thrust increases when Helix angle Ψ _____
   (a) decreases (b) is Constant (c) increases (d) None of above.
8. The sum of Helix angle of Worm and Helix angle of gear in Worm and worm wheel is always ____ (a) 45° (b) 180° (c) 22.5° (d) 90°
9. Write 3 types of progression methods for stepped regulations of speeds in multi speed gear box.
10. What are the basic considerations in design of multi speed gear box.( any three considerations)
11. State functions of Compression rings and Oil control rings in case of piston.
12. What is the need of piston clearance in Cylinder of an I.C .Engine.
13. Crank pin of Crank shaft assembly is subjected to _____ , _____ and _____( Type of stress).
14. Draw the neat figure of connecting rod showing its construction.
15. What do you understand by 6x7wire rope? Draw a figure of said wire rope section.

**Q.2** Answer the following questions. (Attempt any three) **(15)**

A) Give detailed classification of Gears with respect to axis of the gear meshing.
B) Draw the figures of Bevel gear and Spur gear showing standard nomenclatures.
C) Differentiate between Wet and Dry Cylinder Liners with necessary figures.
D) Define Following Terms in brief in case of Gears : ( Each 1 marks)
   (i) Crowning of Gear tooth
   (ii) Pitting
   (iii) Scoring
   (iv) Interference
   (v) Pressure angle

**Q.3** A) Following Data refers to a spur gear pair: **(07)**

| Parameter | Pinion | Gear |
|---|---|---|
| Steel Grade | C50 | C35 Mn75 |
| UTS , Mpa | 700 | 600 |
| BHN | 240 | 225 |
| p.c.d,mm | 48 | 144 |
| Number of teeth | 24 | 72 |
| Tooth System | 20 ° Full Depth Involute | 20 ° Full Depth Involute |
| Speed, r.p.m | 1440 | 480 |

Lewis form Factor, $Y = \pi[0.154 - \frac{0.912}{Z}]$,Service Factor $k_a$= 1.5 ,load Concentration factor $k_m$=1,Velocity Factor $kv = \frac{3}{3+V}$,Wear Factor K= 0.156[BHN/100]$^2$ ,MPa, Factor of Safety=1.5,Face Width b=10 times module, mm

Find Out Beam Strength, Wear Strength, Maximum Static load gear can Transmit, Rated Power (KW).

B) In a Helical gear pair, a helical Pinion ( 55C8, Sut=720 MPa) having 21 teeth is to mesh with a gear ( 40C8,Sut=580 MPa) .The gear pair is required to transmit 10 kW power from an electric motor running at 1000 r.p.m to a machine running at 300 r.p.m. the starting torque of the motor is 125% of the rated torque. Factor of safety required is 1.25,load Concentration factor $k_m$=1,Face width= 10 $m_n$ , Recommended Normal Module $m_n$ between 2 to 4 mm, Tooth System 20 ° full depth involute, Helix angle= 25°,Machining Requirement - Grade 6,Wear Factor K= 0.16[BHN/100]$^2$ ,MPa, Lewis form Factor, $Y' = [0.484 - \frac{2.87}{z'}]$,Gear hardness= 300 BHN, Pinion Hardness= 350 BHN, Velocity Factor $Kv = \frac{5.6}{5.6+\sqrt{V}}$ **(08)**

Calculate :

(i) Module by considering beam strength and wear Strength criteria and velocity factor on account of Dynamic load.

(ii) Specification of gear pair: number of Teeth, face width, p.c.d, addendum, dedendum, centre distance.

**OR**

B) A 4 stoke petrol engine of 7500 W (Brake Power),running at average Engine speed at 1200 rpm. Indicated mean effective pressure=0.45 MPa, Maximum explosion pressure= 3.2 MPa, Mechanical Efficiency=80%,Allowable stress for C.I cylinder= 40 MPa, Allowable stress for Ni-steel bolt= 70 MPa, Assume reboring factor =4 mm, Length of piston =1.25 D, $K_1$= 0.35 for cylinder head. Thickness of cylinder flange $t_f$= 1.3t,Thickness of cylinder head $th = K1D\sqrt{\frac{Pmax}{\sigma all\ head}}$ **(08)**

Design the cylinder of 4-Stroke in following contexts. Bore(D) , Stroke length(L),Length of cylinder (Lc) ,Thickness of cylinder wall(t) and flange($t_f$), Thickness of cylinder head($t_h$),The size and number of bolts required to fasten the cylinder head, Diameter of stud p.c.d, and pitch of studs ,diameter of flange.

Drawing of Cylinder is mandatory showing standard nomenclature.

**Q.4** A) Design a crane hook for lifting capacity of 5tonnes. Yield strength in tensile is 336 mpa. Factor of safety as 4. It is made up of forged steel and has triangular section. Design all dimensions in mm,all proportions and reference formulas are in mm. **(07)**

Take:

J=0.75 C, h =0.9 C, bi=0.65h,$R_1$=0.75 h,$R_2$=0.125h,$O_1O_2$=0.125h,Ri=0.5C,C/S area =( hbi)/2,

Ro= Ri+ h

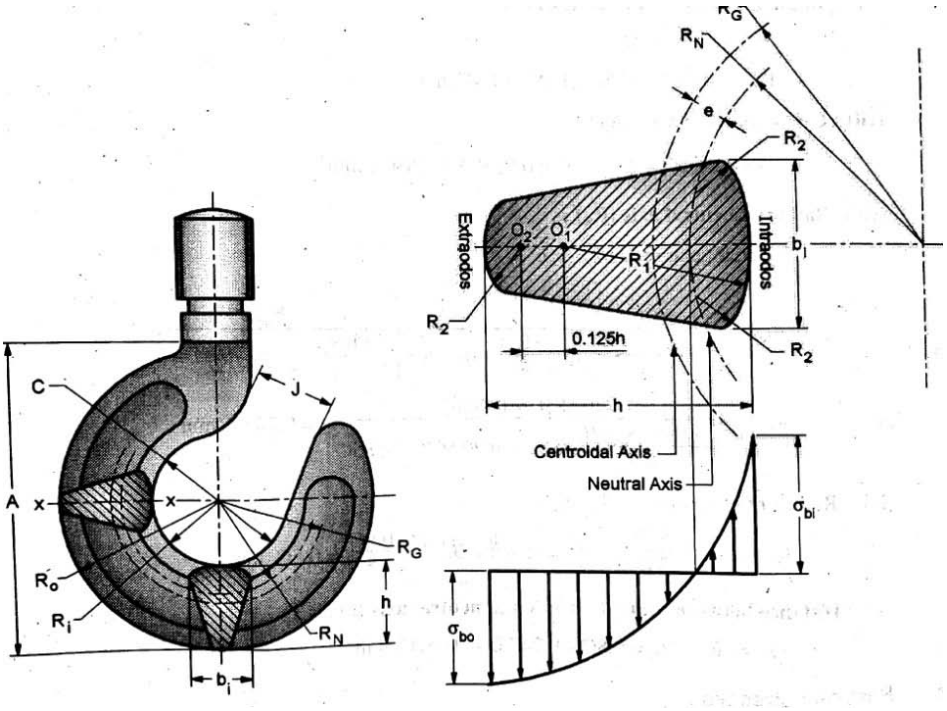


Figure 01 : Crane Hook and triangular C/S

$$R_N = \frac{\left(\frac{b_i + b_o}{2}\right) h}{\left(\frac{b_i R_o - b_o R_i}{h}\right) \log_e\left(\frac{R_o}{R_i}\right) - (b_i - b_o)}$$

$$R_G = R_i + \frac{h\,(b_i + 2b_o)}{3\,(b_i - b_o)}$$

$$e = R_G - R_N$$

**OR**

A). Following data refers to a Cast iron piston for a single cylinder four –stroke diesel engine. **(07)**

Design Piston Head, Piston Barrel, Piston rings and Piston skirt. Assume additional data, if required.( figure required to draw).

Cylinder bore D= 110 mm, Piston stroke L= 120 mm, Speed=2000 r.p.m, Indicated mean effective pressure=0.75 MPa, Maximum Gas pressure $pmax$ = 5 MPa, Mechanical Efficiency=80 %,Fuel Consumption=0.15 kg per brake power hour, H.C.V= 42000 kJ/kg, Thermal conductivity of C.I piston= 46.6 W/m°c, Constant x= 0.05 ,Permissible temperature difference for piston= 220 °c, Permissible tensile stress for C.I piston=35 MPa, Permissible Bending stress for piston pin=85 MPa, Permissible bearing pressure between piston skirt and cylinder=0.4MPa, Permissible bearing pressure for piston pin =20 MPa, Permissible bending stress for piston rings=80 MPa, Radial wall pressure $Pw$ between ring and cylinder wall=0.04 MPa.

Radial thickness of piston rings $tr = D\sqrt{\frac{3Pw}{\sigma br}}$, Axial width of piston rings ($b_r$)=0.75 tr to 1 tr,

Width of lands between ring grooves= 0.75 $b_r$ to $1b_{r,\text{ width of top land}}$ (bo)= $1t_{ph}$ to 1.25 $t_{ph}$

$Take, thickness\ of\ piston\ Head\ tph = \frac{x\ (bsfc)\ (B.P)(H.C.V)}{4\pi K\ \Delta T}$ ,m for thermal considerations, , $tph$ =0.433D $\sqrt{pmax/\ \sigma allowable}$ for strength considerations.

B) Explain the design procedure for 6 speed gear box step wise. **(08)**