Enrollment No: _____        Exam Seat No:_____

# C.U.SHAH UNIVERSITY
## Summer Examination-2016

**Subject Name: Automobile Component Design**

**Subject Code: 4TE06ACD1**          **Branch: B.Tech. (Automobile)**

**Semester: 6    Date: 11/05/2016          Time: 2.30 To 5:30          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.
  (5) Use of PSG Design Data Book is permitted in exam.

---

**Q-1**          **Attempt the following questions:**                                    **(14)**
  **a)**   The size of gear is usually specified by
         (a) pressure angle    (b) pitch circle diameter
         (c) circular pitch     (d) diametral pitch
  **b)**   Automotive crankshafts are made by,
         (a) casting process        (b) machining from rolled stock
         (c) drop forging process  (d) welding process
  **c)**   The function of piston skirt is
         (a) to provide bearing surface for side thrust
         (b) to support gas load
         (c) to support gudgeon pin
         (d) to seal the cylinder and prevent leakage of oil past piston
  **d)**   Which of the following is antifriction bearing?
         (a) journal bearing
         (b) pedestal bearing
         (c) collar bearing
         (d) needle bearing
  **e)**   The contact ratio for gears is
         (a) zero                (b) less than one
         (c) greater than one (d) none of these
  **f)**   The ball bearings are usually made from
         (a) low carbon steel
         (b) medium carbon steel
         (c) high speed steel
         (d) chrome nickel steel
  **g)**   Whipping stress is due to
         (a) vibrations of crankshaft
         (b) reciprocating motion of piston

(c) inertia force on connecting rod
(d) obliquity of connecting rod

**h)** The main function of an automobile gearbox is
(a) to reduce speed        (b) to increase speed
(c) to provide variable speeds (d) to increase power

**i)** Buckingham's equation of gear tooth is based on
(a) maximum crushing stress in gear tooth
(b) maximum bending stress in gear tooth
(c) maximum shear stress in gear tooth
(d) maximum contact stress in gear tooth

**j)** The minimum number of teeth on the pinion in order to avoid interference for $20°$ stub system is
(a) 12        (b) 14        (c) 18        (d) 32

**k)** If $b$ denotes the face width and L denotes the cone distance, then the bevel factor is written as
(a) b / L        (b) b / 2L        (c) 1 – 2 b.L        (d) 1 – b / L

**l)** In case of hypoid gears, the axes of shafts are
(a) parallel
(b) intersecting
(c) non-parallel and non-intersecting and the teeth are straight
(d) non-parallel and non-intersecting and the teeth are curved

**m)** Which of the following statement is wrong for a connecting rod?
(a) The connecting rod will be equally strong in buckling about X-axis, if $I_{xx} = 4 I_{yy}$.
(b) If $I_{xx} > 4 I_{yy}$,,the buckling will occur about Y-axis.
(c) If $I_{xx} < 4 I_{yy}$,the buckling will occur about X-axis.
(d) The most suitable section for the connecting rod is T-section.

**n)** The listed life of a rolling bearing, in a catalogue, is the
(a) minimum expected life        (b) maximum expected life
(c) average life        (d) none of these


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

**Q-2**        **Attempt all questions**

**a)** Explain the different causes of gear tooth failures and suggest possible remedies to avoid such failures        **04**

**b)** Design a suitable gear box that has a minimum speed =125 rpm, maximum speed =1600 rpm in 12 steps. The electric motor is connected to the gear box through a belt drive and runs at 1500 rpm and transmits of 5 kW. The reduction through V-Belt drive between motor and input shaft=1.2 :1.Determine,        **10**
1. Standard speeds
2. Draw the structure and speed diagram for the arrangement.
3. Determine no. of teeth in each gear.
4. Draw the gear box layout.

**Q-3**        **Attempt all questions**

**a)** What is formative number of teeth in helical gear? Derive the expression for formative number of teeth in helical gears.        **04**

**b)** The following particulars refers to a spur gear pair: **10**

| Particulars | Pinion | Gear |
|---|---|---|
| Material | C-50 Steel | C-35 Mn 75 Steel |
| Allowable static stress | 116 MPa | 100 MPa |
| BHN | 240 | 220 |
| Pitch Diameter | 48 mm | 144 mm |
| No.of Teeth | 24 | 72 (20° Full Depth) |
| RPM | 1440 | 480 |

Take Service factor $(K_s)=$ 1.5,Lewis form factor :$Y =0.154 -(0.912/Z)$ Velocity factor $(K_v)= 3/(3+V)$, Dynamic factor $(C) =230$ N/mm, Wear factor$(K)= 0.156$ $[BHN/100]^2$ N/mm$^2$

Specify the kW Capacity of the gear unit.

**Q-4**      **Attempt all questions**

**a)** Explain thermal consideration while designing worm and worm wheel drive. **04**

**b)** A pair of precision cut bevel gears connect two shafts at right angles and transmit 7.5 kW. Find the necessary module and gear dimensions for the following specifications: **10**

| Particulars | Pinion | Gear |
|---|---|---|
| Material | Steel | C.I. |
| Ultimate strength | 540 MPa | 360 MPa |
| No.of Teeth | 20 | 80 |
| Speed | 1000 rpm | 250 rpm |
| Tooth Profile | 14 ½ ° Composite | |
| BHN | 200 | 160 |

Take Factor of safety= 6, Service Factor $(K_s)=1.25$ ,Lewis form factor:$Y=0.124 - (0.684/Z_f)$, and Velocity Factor $(K_v)= 6/(6+V)$

**Q-5**      **Attempt all questions**

**a)** Explain Bearing Life and Reliability of bearing. **03**

**b)** What are the desirable properties of lubricating oil? Why additives are added in the lubricating oils? **04**

**c)** A full journal bearing of 50 mm diameter and 100 mm long has a bearing Pressure of 1.4 N/mm$^2$. The speed of the journal is 900 rpm and the ratio of journal diameter to the diametral clearance is 1000. The bearing is lubricated with oil whose absolute viscosity at the operating temperature of 75°C may be taken as 0.011 kg/m-s. The room temperature is 35°C. Find: 1.Coefficient of friction 2. Power Lost in Friction 3. The amount of artificial cooling required, and 4. The mass of the lubricating oil required, if the difference between the outlet and inlet temperature of the oil is 10°C. **07**

Take specific heat of the oil as 1850 J / kg / °C and heat dissipated Coefficient $C_d = 280$ W/m$^2$ /° C and k=0.002

**Q-6**      **Attempt all questions**

**a)** How antifriction bearings are designated? Explain. **03**

**b)** Explain the important parameters affecting the design of bearing. **04**

**c)** For SKF 6310 bearing is to operate on the following work cycle. **07**
Radial load of 600 N, Axial Load=250 N at 800 rpm for 25 % of the time.
Radial load of 700 N, Axial Load=200 N at 1000 rpm for 55 % of the time.

Radial load of 300 N, Axial Load=150 N at 1200 rpm for 30 % of the time. Determine the rating life of bearing in hours. Also Find the life that 50 % of the bearing will exceed before fatigue failure. The inner ring rotates. Take Dynamic capacity of bearing= 47.5 kN , Static capacity of bearing= 36 kN, X=0.56 and Y=2 and service load factor=1

**Q-7**     **Attempt all questions**

    **a)**    Sketch and explain the various stresses induced in the crankshaft.     **03**

    **b)**    Why an I-section is usually preferred to round section in case of connecting rods?     **04**

    **c)**    The cylinder of a four stroke diesel engine has the following specifications: Brake power = 7.5 kW; Speed = 1500 rpm; Maximum gas pressure = 3.2 MPa; Indicated mean effective pressure = 0.45 MPa; Mechanical efficiency = 80%;Allowable stress for C.I. Cylinder=40 MPa, Allowable stress for Bolt=70 MPa, Calculate:     **07**
1. Bore and stroke of the engine taking L/D=1.25
2. Thickness of the cylinder wall and flange (Take, Reboring factor (k) = 3.5 mm)
3. Thickness of the cylinder head
4. Size and number of bolts required to join the cylinder head

**Q-8**     **Attempt all questions**

    **a)**    Sketch a valve gear mechanism of an internal combustion engine and label its various parts.     **04**

    **b)**    Design a cast iron piston for a single acting four stroke engine for the following data: Cylinder bore=100 mm; Stroke=125 mm; Maximum explosion pressure=2.5 MPa ;Power developed = 80 kW; Fuel consumption=180 gm/kwh; Higher calorific value of fuel=$45\times10^3$ kJ/kg; Speed = 2500 rpm; Allowable stress for C.I. Piston=40 MPa; Allowable bearing pressure for piston pin of steel=120 MPa; Allowable bearing pressure for small end of bearing=25 MPa; Take three compression rings and one scrapper ring, Take Thermal Conductivity K = 175 w/ $m^{2\,0}$c. m and [Tc-Te] = $55^0$C for aluminium alloy. Any other data required for the design may be assumed.     **10**