Date: 03-06-20012   Time: 3 hrs
Marks: 80   Weightage: 40%

Note: 1. Answer all questions. This paper consists of 2 pages.
       2. Marks are shown in the brackets against each question.
       3. Assume the data suitably if necessary.
       4. Draw freehand sketches for all except for pressure vessels.
       5. Use the data sheet enclosed.

Question 1

A pair of 20^0 stub involute tooth spur gears of 6 mm module is designed with the following data:

Speed of pinion	= 320 rpm,
Velocity ratio	= 1:4
Static stress of cast iron gear and pinion	= 60 MPa
No of teeth on pinion	= 30
Face width	= 80 mm
Endurance strength	= 84 MPa
Deformation factor	= 50
Materialcombination factor for wear	= 1.4
Velocity Factor, C_v	= $3/(3 + v)$, v = pitch line velocity in m/s.

Tooth form factor for 20^0 stub teeth, $y = 0.175 - 0.841/T$, T = Number of teeth.

Check the design for the static, dynamic and wear loads.   [12M]

Question 2

A pair of straight bevel gears is mounted on perpendicular shafts, consists of a 30 teeth pinion meshing with a 48 teeth gear. The module is 4 mm. Calculate the pitch circle diameters and pitch angles of the pinion and gear and the cone distance. Draw the sketch of the gear drive, showing the diameters and pitch angles.   [8M]

Question 3

A pair of worm and worm wheel is designated as 3/60/10/6. The worm is transmitting 6 kW at 1400 r.p.m. Determine the tangential, axial and separating forces of both worm and wheel. The coefficient of friction and normal pressure angles are 0.1 and 20^0 respectively.   [8M]

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Question 4

A motor shaft rotating at 1500 rpm has to transmit 12kW to a low speed shaft with reduction of 4:1. The teeth are 20^0 involute of 8 mm module with 30 teeth on pinion. Both the

gear and pinion are made of steel with a static stress of 150 MPa. The service factor is 0.8.

Velocity Factor, C_v = $3/(3+v)$, v = pitch line velocity in m/s.
Tooth form factor for 20^0 stub teeth, y =   0.124 - 0.684/T, T = Number of teeth.
The weights of gear and pinion are 80 N and 50 N respectively. Find the resultant loads on gear and pinion. Design suitable diameters for the gear and pinion shafts if the shear stress of the shaft material is 40MPa.   **[12M]**

Question 5

(a) A cast iron pipe in a hydraulic circuit is subjected to an internal pressure of 50 MPa. The inner diameter of pipe is 20 mm. Find the outer diameter using suitable equation if allowable stress is 200 MPa.   **[4M]**

(b) A steel tank for shipping gas is to have an inside diameter of 200 mm. The gas pressure and permissible stresses are 10 MPa and 55 MPa respectively. Design the tank using suitable equations.   **[4M]**

Question 6

(a) A radial load acting on a ball bearing is 5 kN and the expected life for the 90% of the bearing is 8000 hrs. Calculate the dynamic load carrying capacity of the bearing, when the shaft rotes at 1500 r.p.m.   **[4M]**

(b) A ball bearing, subjected to a radial load of 6 kN and expected to have a life of 8000 hrs at 1450 rpm with a reliability of 99%. Calculate the dynamic load capacity of the bearing so that

it can be selected from the manufacturer's catalogue based on a reliability of 90%.   **[4M]**

Question 7

A high pressure cylinder with internal and external diameters 200 mm and 240 mm respectively is subjected to an external pressure of 20 MPa. Draw the all the principal stress variation diagrams.   **[12M]**

Question 8

A pressure vessel made of cast iron is subjected to an internal pressure of 50 MPa. The inner and outer diameters of cylinder are 20 mm and 40 mm respectively. Draw the stress distribution diagrams of all principal stresses across the wall thickness.   **[12M]**

Date: 29-02-20Φ12   **Time: 50 minutes**
Marks: 25   **Weightage: 25%**
Note: 1. Answer all questions.
       2. Marks are shown in the brackets against each question.₹
       3. Draw the free hand sketches.

Question 1
A pair of straight teeth spur gears is to transmit 25 kW when the pinion rotates at 250 rpm. The velocity ratio is 1:4. The allowable static stresses for the pinion and gear materials are 120 MPa and 100 MPa respectively. The pinion has 16 teeth and its face width is 12 times the module. Determine the module, face width, and pitch circle diameters of both the pinion and gear from the stand point of strength only, taking into consideration of the effect of dynamic loading. Take service factor as 0.8. The tooth form factor y can be taken as

$$y = 0.154 - 0.912/T \text{ and}$$

the velocity of factor C_v as

$$C_v = 3/(3 + v), \text{ where v is in m/s.} \qquad \textbf{[8M]}$$

Question 2
A spur gear drive is required to transmit a maximum power of 22.5 kW. The velocity ratio is 1:2 and speed of pinion is 200 r.p.m. The center distance between the shafts is 600 mm. The static stress for both the gear and pinion materials is 60 MPa and face width is 10 times the module. Find the module, face width and number of teeth on each gear.

Lewis form factor   = $0.154 - 0.912/T$
Velocity factor   = $3/(3 + v)$
Service facto   =   1.0   **[7M]**

Question 3
A motor shaft rotating at 1500 rpm has to transmit 22 kW to a low speed shaft with reduction of 4:1. The teeth are $14\frac{1}{2}^{0}$ involute of 8 mm module with 30 teeth on pinion. Both the gear and pinion are made of steel with a static stress of 200 MPa. The service factor is 0.8.

   Velocity Factor, C_v = $3/(3 + v)$, v = pitch line velocity in m/s.
   Tooth form factor for 20^{0} stub teeth, y = $0.124 - 0.684/T$, T = Number of teeth.

    The weights of gear and pinion are 85 N and 45 N respectively. Find the resultant loads on gear and pinion. Design suitable diameters for the gear and pinion shafts if the shear stress of the shaft material is 40 MPa.   **[10M]**

NAME:_____

ID NO:_____

BITS PILANI, DUBAI CAMPUS
DUBAI INTERNATIONAL ACADEMIC CITY,DUBAI
ME C451 MECHANICAL EQUIPMENT DESIGN
I SEMESTER 2011-2012

Q U I Z II

Max. Marks: 7   Date:11-04-12

Weightage: 7%
                                                     Duration: 20 Min.

- Answer all questions.
- Questions 1 to 6 carry ½ mark each whereas questions 7 and 8beach carries 2 marks.
- For questions from 1 to 6, tick against the correct answer in the brackets given,
- Over writing answers are not valid.

Question 1
Bevel gears are used for connecting   [   ]
A.Coplanar and parallel shafts
B. Coplanar and intersecting shafts
C.Non intersecting and non parallel shafts

Question 2
Modified Lewis equation is used for Bevel gears as   v [   ]
A. face width is not uniform
B. number of teeth is not equal
C. shafts are not parallel

Question 3
Pitch angles of gear and pinion of Bevel gear depends on   [   ]
A.speeds
B. number of teeth
C .pitch circle diameters

Question 4
Separating force depends on   [   ]
A.Pitch angles and teeth
B. bending load and form factor
C.tangential load and pressure angle

1

Question 5

Bevel Gear thrust is a function of   [   ]

A. pitch angle and no of teeth

B. power and speed   *Pressure*

C. separating force and ~~pitch~~ angle

Question 6

Cone distance is a function of   [   ]

A.pitch angles

B. number of teeth

C.diameters (*Pitch Circle*)

Question 7

Find the cone distance, pitch circle diameters and pitch angles of a pair of straight bevel gears mounted on perpendicular shafts, consisting of no of teeth on pinion and gear 30 and 48 respectively and 6 mm module.

Question 8

Draw the freee hand sketch of a pair of bevel gears whose shaft axes are perpendicular to each other and also find the torque transmitted on pinion if the power is 12 Kw at 1400 rpm.

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NAME:_____

ID NO:_____

BITS PILANI, DUBAI CAMPUS
ME C451 Mechanical Equipment Design
II SEMESTER 20011-2012

Q U I Z I

Max. Marks: 08   Duration: 20 Min.
Weightage: 8%   Date: 22-02-2012

- Answer all questions.
- Put √ mark in the brackets provided against the suitable answer for the questions in PART I and answer the questions in <u>PART II</u>
- Each question in PART I carries ½ mark whereas questions in PART II carries 1 mark each.

P A R T I

Question 1
If the shafts are neither parallel nor intersecting, which of the following gears are used.

    A   worm gears   [   ]

    B   spur gears   [   ]

    C   bevel gears   [   ]

    D   none of the above   [   ]

Question 2
Lewis equation is based on the pure bending of gear tooth, treating it as

    A   fixed bam   [   ]

    B   simply supported beam   [   ]

    C   cantilever beam   [   ]

    D   None of the above   [   ]

Question 3

Tooth form factor is a function of

A   pressure angle   [   ]

B   pitch circle   [   ]

C   thickness   [   ]

D   number of teeth   [   ]

Question 4

The dynamic load is calculated using

A Lewis equation   [   ]

B Barth equation   [   ]

C Buckingham equation   ↓   [   ]

D none of the above   [   ]

Question 5

Service factor of gear depends on   [   ]

A number of hrs of service only   [   ]

B type of load only   [   ]

C both the type of load and number of hrs of service   [   ]

D number of teeth   [   ]

Question 6

If the gear and pinion are made of same material, design is based on

A gear only   [   ]

B pinion only   [   ]

C both gear and pinion   [   ]

D none of the above   [   ]

Question 7

Which of the following statements violates the law of gearing?

A circular pitch of both the meshing gears must be equal   [   ]

B module of both the meshing gears must be same   [   ]

C pitch line velocity of both the meshing gears must be same. [   ]

D pitch circle diameters of the meshing gears are inversely proportional to
the number of teeth on them.   [   ]

Question 8
For the safe design of spur gears, which one of the following statements is wrong?
A static tooth load must be greater than dynamic load   [   ]
B wear tooth load must be greater than dynamic load   [   ]
C tangential load must be less than dynamic load   [   ]
D both the static tooth load and wear tooth load must be equal.   [   ]

PART II

Question 9
Write down the formula for strength factor.

Question 10
What is the significance of Lewis equation and write down the equation.

Question 11
What is tooth bending failure and how do you rectify it?

Question 12
What are the parameters on which wear tooth load depends?

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