BITS PILANI, DUBAI CAMPUS
DUBAI INTERNATIONAL ACADEMIC CITY, DUBAI
FIRST SEMESTER 2012-2013

COMPREHENSIVE EXAMINATION

ME C451 MECHANICAL EQUIPMENT DESIGN

Date: 10-01-2013 **Time: 3 hrs.**
Marks: 80 **Weightage: 40%**

Note: 1. Answer all questions.
2. Marks are shown in the brackets against each question.
3. Use the data sheet provided.
4. Draw free hand sketches/drawings to scale
5. Assume logically the missing data, if any.
6.This question paper contains 2 pages, printed on both sides.

Question 1

A pair of straight teeth spur gears is to transmit 25 kW when the pinion rotates at 320 rpm. The velocity ratio is 1:2. The allowable static stresses for the pinion and gear materials are 100 MPa and 120 MPa respectively. The pinion has 20 teeth and its face width is 15 times the module. Determine the module, face width, and pitch circle diameters of 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

$y = 0.154 - 0.912/$ (No. of teeth) and

the velocity of factor C_v as

$C_v = 3/(3 + v)$, where v is in m/s.

Check the design for dynamic and wear loads. The deformation factor is 80 and load stress factor for the wear as 1.4.Draw free hand dimensional sketch. **[14Marks]**

Question 2

A pair of straight bevel gears is mounted on shafts, which are intersecting at right angles. The number of teeth on pinion and gear are 35 and 65 respectively. developing 5 kW rated power. The pinion and gear are made of steel for which bending stress is 220 N/mm^2. The form factor, module and face width are 0.35, 6 mm and 24 mm respectively. Determine the pitch angles of gear and pinion, cone distance and beam strength. **[6M]**

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I SEMESTER 2012-2013

T E S T II (Open Book)

Marks: 20 **Duration: 50 Minutes**
Weightage: 20% **Date: 19-12-12**

- **Answer all questions.**
- **Marks are shown in brackets against each question.**
- **Assume any missing data suitably.**

Question 1

A high pressure cylinder consists of a steel tube with inner and outer diameters of 30 mm and 50 mm respectively. It is jacketed by an outer steel tube with an outer diameter of 70 mm. The tubes are assembled by a shrink fit in such a way that maximum principal stress induced in any tube is limited to 120 MPa. Calculate shrinkage pressure, the compressive and elongated deformations. Draw free hand sketch. **[7M]**

Question 2

A cast iron steel pipe of 120 mm internal diameter is subjected to an internal pressure of 14 MPa. Design suitable thickness of the pipe. Take ultimate tensile stress is 200 MPa. Draw free hand sketch. **[7M]**

Question 3

A ball bearing is subjected to a radial load of 5kN is expected to have a life of 30 days at 1500 rpm with a reliability of 99%. Calculate the dynamic load capacity of bearing so that it can be selected from the manufacturer's catalogue with a reliability of 93%. **[6M]**

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T E S T I (CLOSED BOOK)

ME C 451 MECHANICAL EQUIPMENT DESIGN

Date: 07-11-20012 **Time: 50 minutes**
Marks: 25 **Weightage: 50%**
Note: 1. Answer all questions.
2. Marks are shown in the brackets against each question.
3. Draw the free hand sketches for all questions.
4.Use the Data sheet supplied.
5.Assume any missing data logically.

Question 1
A pair of straight teeth spur gears is to transmit 30 kW when the pinion rotates at 350 rpm. The velocity ratio is 1:3 The allowable static stresses for the pinion and gear materials are 130 MPa and 120 MPa respectively. The pinion has 18teeth and its face width is 14 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

$$C_v = 3/(3 + v), \text{ where v is in m/s.}$$ **[10M]**

Question 2
A motor shaft rotating at 1400 rpm has to transmit 22 kW to a low speed shaft with reduction of 4:1. The teeth are 20^0 involute of 6 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 90 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 45 MPa. **[15M]**

Question 3

A pair of straight bevel gears is mounted on perpendicular shafts, consists of a 30 teeth pinion meshing with a 60 teeth gear. The module is 8 mm. Calculate the pitch circle diameters and pitch angles of the pinion and gear and the cone distance. **[5M]**

Question 4

A pair of worm and worm wheel is designated as 3/60/10/6.Find all dimensions of worm and gear. Find the power transmitted for a gear drive, in which worm is rotating at 300 rpm. The tangential load is 3 kN. **[5M]**

Question 5

A thick cylindrical tube with 50 mm and 75 mm as inner and outer diameters respectively is subjected to an internal of 50 MPa. Draw the radial and tangential stress distribution diagrams to scale proportionate to the data. **[15M]**

Name: _____

ID NO: _____

BITS PILANI, DUBAI CAMPUS
ME C451 Mechanical Equipment Design
I SEMESTER 2012-2013
Q U I Z II

Date: 06-12-2012

Marks: 07 **Duration: 20 Min.**

- **Answer all questions.**
- **Question no 1 to 4 carry 1 mark each whereas question no5 and 6 carry 11/2 marks each.**

Question 1
Draw free hand sketch stress variation of gun barrel when it is subjected to outer pressure

Question 2
What are the design criteria for identifying a pressure vessel?

Question 3
What is the maximum stress in a boiler vessel? Write down its relationship with other stresses

Question 4

If a high pressure pipe is subjected to an internal pressure, mention briefly how all the stresses vary along its cross section?

Question 5

Find the internal pressure of a boiler shell whose internal and external diameters 250 mm and 270 mm respectively. Take yield point stress as 150 MPa.

Question 6

A LPG storage tank of 0.030 m^3 is subjected to an internal pressure of 25 MPa. It is a cylindrical tank with its length as twice its diameter. The tank is made of plain carbon steel whose ultimate stress is 390 MPa. Choosing a suitable factor of safety, Find the optimum dimensions of the tank.

Name:_____ A

ID NO:_____

BITS PILANI, DUBAI CAMPUS
DUBAI INTERNATIONAL ACADEMIC CITY,DUBAI
ME C451 MECHANICAL EQUIPMENT DESIGN
I SEMESTER 20101-2012

Q U I Z I

Max. Marks: 08
Weightage: 8%

Date: 25-09-2012
Duration: 20 Min.

- **Answer all questions.**
- **Questions 1 to 8 carry ½ mark each and 9 to 12 carry 1 mark each.**

Question 1
Give the types of gears used according to the position of teeth on gear surface.

Question 2
What is the basis of Lewis formula? Give its significance.

Question 3
Give possible remedies for wear and corrosion tooth failures.

Question 4
What are the factors on which tooth form factor depends?

Question 10

If the wear tooth load, static tooth load and incremental load are 50 KN, 25 kN and 5 kN respectively, check whether the design is safe or not? The gear is subjected to a normal load of 6kN and pressure angle is 20^0.

Question 11

Draw the free hand sketch of the tooth profile of spur gear showing all the load s acting on it.

Question 12

Find the components of normal load for a 20^0 full depth involute toothed gears if the power transmitted is 20 Kw at 320 rpm with a module of 6mm and no of teeth is 25. Assume service factor as 0.8.