Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**BE - SEMESTER–VI • EXAMINATION – SUMMER 2013**

**Subject Code: 160201 Date: 24-05-2013**

**Subject Name: Automobile Component Design**

**Time: 10.30 am - 01.00 pm Total Marks: 70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

**Q.1** **(a)** Explain the general consideration in Machine Design. Discuss the selection of materials for engineering purposes. **07**

**(b)** Classify Rolling contact Bearings with neat sketch. Also Define following (1) Life of Bearing (2) Reliability of Bearing **07**

**Q.2** **(a)** Explain Load distribution on balls (stribeck's equation). **07**

**(b)** For a single row, deep-groove, ball bearing, Dynamic load capacity = 5,590N, Static load rating = 2,500N. Actual load on bearing are = 625N, radial load = 1250N. Determine the equivalent load and life of ball bearing if **07**

a) Inner race is rotating
b) Outer race is rotating

**OR**

**(b)** A ball bearing subjected to radial load of 5KN is expected to have a life of 8000hr at 150 r.p.m. with a reliability of 99%. Calculate the dynamic load capacity of the bearing, so that it can be selected from the manufacturer catalogue based on a reliability of 90%. **07**

**Q.3** **(a)** Explain the design consideration of Gear Drive. Discuss the Design procedure of spur gear. **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. 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 both 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 **07**

$y = 0.154 - (0\ 912/\text{No of teeth})$

and the velocity factor $C_v = 3/(3+v)$ , where v is in m/s

Assuming steady load conditions, The service factor Cs = 1

**OR**

**Q.3** **(a)** Determine the beam strength of helical gears, also explain the following **07**

1) Helix angle 2) Axial pitch 3) Normal Pitch.

**(b)** A pair of cast iron bevel gears connect two shafts at right angles. The pitch diameters of the pinion and gear are 80 mm and 100 mm respectively. The tooth profiles of the gears are of 14 1/2º composite form. The allowable static stress for both the gears is 55 MPa. If the pinion transmits 2.75 kW at 1100 r.p.m., find the module and number of teeth on each gear from the standpoint **07**

of strength and check the design from the standpoint of wear. Take surface endurance limit as 630 MPa and modulus of elasticity for cast iron as 84 $kN/mm^2$.

**Q.4** **(a)** Explain the Design of Piston with neat sketch **07**

**(b)** Design a cast iron piston for a single acting four stroke engine for the following data: **07**

Cylinder bore = 100mm; Stroke = 125mm; Maximum gas pressure = $5N/mm^2$

Indicated Mean effective pressure = $0.755N/mm^2$ ;

Mechanical efficiency = 80%; Fuel consumption = 0.15kg per brake power per hour; Higher calorific value of fuel = $42 \times 10^3 Kj/kg$; Speed = 2000r.p.m.

Taking Permissible bending or tensile stress for C.I = $38N/mm^2$;

*C* = Constant representing that portion of the heat supplied to the engine which is absorbed by the piston is 0.05. cast iron , Heat conductivity factor *k* = 46.6 W/m/°C, and Temperature difference at the centre of the piston head and temperature at the edges piston head is = 220°*C;*

Pressure of the gas on cylinder wall is 0.035;

Allawable tensile or bending stress for C.I ring is $90N/mm^2$ ;

Bearing pressure on the piston barrel is $0.45\ N/mm^2$

Bearing pressure at small end of connecting rod is $25\ N/mm^2$

Bending stress for piston pin is $140N/mm^2$

**OR**

**Q.4** **(a)** Explain Design of Cylinder with neat sketch **07**

**Q.4** **(b)** Four stroke diesel engine has following specifications: **07**

Brake Power = 5kw;

Speed = 1200r.p.m; Indicated mean effective pressure = $0.38N/mm^2$ ;

Mechanical efficiency = 80%.

Length of stroke l = 1.5D;

Clearance on both the side of cylinder = 15%;

Maximum pressure in the engine cylinder is 9 times mean effective pressure;

Cylinder head constant = 0.1;

Allowable stress for cylinder head = $42N/mm^2$ ;

Core diameter of stud = 0.83x Nominal diameter of studs;

Tensile stress for material of studs = $65N/mm^2$ ;

Determine

1). Bore and length of cylinder;

2) Thickness of cylinder head;

3) Size of studs for the cylinder head.

**Q.5** **(a)** Explain the Design of Crankshaft. **07**

**(b)** Design a crank shaft of a single cylinder petrol engine with following specifications: shaft material 60C4, for which permissible stresses in bending and compression can be taken as $60N/mm^2$ and $75N/mm^2$, respectively. **07**

Maximum gas pressure on piston = 2.5MPa

Cylinder bore = 95mm

L/R ratio = 4.5

Where, L = connecting rod length , R= crank radius = 60mm

For crankpin:

l/d = 1.0, allowable bearing pressure = 13MPa

for main bearings: l/d = 1.5, where d = crankpin diameter

Allowable pressure in main bearing = 7MPa

Side crank carries a flywheel of 200kg mass between two journal bearings of crank shaft. Cylinder of engine is horizontal. Distance between two

journal bearings = 200mm.

**OR**

**Q.5** **(a)** Explain the Design of Connecting Rod with neat sketch **07**

**(b)** Design a connecting rod for petrol engine with following data **07**

Piston diameter = 106mm
Weight of reciprocating parts = 22N
Length of the rod centre to centre = 340mm
Stroke = 140mm
RPM = 1600 with 50% overdrive
Compression ratio = 7:1
Estimated maximum explosion pressure =2.5 $N/mm^2$
Take length to diameter ratio for big end bearing as 1.3 and small end bearing as 2 and the corresponding bearing pressures as 10 $N/mm^2$ and 15 $N/mm^2$.
Use Rankine formula for which the numerator constant may be taken as 320 $N/mm^2$ and the denominator constant 1 / 7500.
Factor of safety for connecting rod and bolts = 5

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