B.Tech. SEM -VI Mechanical 2014 Course (CBCS) : SUMMER - 2019
SUBJECT: MACHINE DESIGN – II*

Day: Wednesday
Date: 22/05/2019

S-2019-2756

Time: 02.30 PM TO 06:.30 PM
Max Marks: 60

N.B.:

1) All questions are **COMPULSORY.**
2) Figures to the right indicate **FULL** marks.
3) Assume suitable data if necessary.

Q.1 **a)** What are the principles for the design of machined components? **(10)**

OR

b) What are the principles for the design of powder metallurgy? **(10)**

Q.2 **a)** It is required to design a spur gear speed reducer for a compressor running at 250 r.p.m driven by a 7.5 KW, 1000 r.p.m electric motor. The center distance between the axes of the gear shafts should be exactly 250 mm. The starting torque of the motor can be assumed to be 150 % of the rated torque. The gears are made of carbon steel 50C4 (Sut = 700 N/mm^2). The pressure angle is 20^0 the factor of safety is 2 for preliminary design based on the use of velocity factor. **(10)**

1. Design the gears and specify their dimensions.
2. Assume that the gears are manufactured to meet the requirement of grade 6 and calculate the dynamic load by using Buckingham's equation.
3. Calculate effective load.
4. What is actual factor of safety against bending failure?
5. Using same factor of safety against pitting failure, specify suitable surface hardness for the gears.

   For grade 6 $e = 8 + 0.63\ (m + 0.25\ \sqrt{dp})$

OR

b) A spur pinion having 21 teeth to be made up of plain carbon steel 55C8 (Sut = 720 N/mm^2) is to mesh with a gear to be made up of plain carbon steel 40C8 (Sut = 580 N/mm^2). The gear pair is required to transmit 22 KW power from an I.C engine running at 1000 r.p.m. to a machine running at 300 r.p.m. The starting torque required is 200 % of the rated torque, while the load distribution factor is 1.5. The factor of safety required is 1.5. The face width is ten times the module and the tooth system is 20^0 full depth involute. The gears are to be machined to meet the specification of grade 6. The gear and pinion are to be case hardened to 400 BHN and 450 BHN respectively. The deformation factor C for the gear is 11500e N/mm design the gear pair by using the dynamic factor Kv = 6/ (6 + V) and Buckingham's equation for dynamic load. Take for grade 6 $e = 8 + 0.63\ (m + 0.25\ \sqrt{dp})$ **(10)**

$Fd = 21v(bc + Ftmax)/\ 21\ v + \sqrt{bc + Ftmax}$

P.T.O.

Q.3 **a)** What is formative number of teeth in helical gears? Derive an expression for formative number of teeth in helical gear. Also find the equation for minimum number of teeth required on helical pinion to avoid the interference. **(10)**

OR

b) Explain the following terms with the diagrams. **(10)**

1. Transverse circular pitch and transverse module.
2. Normal circular pitch and normal module.
3. Axial pitch.
4. Normal pressure angle.
5. Face width and face advance.

Q.4 **a)** A transmission shaft is supported by two deep groove ball bearings at two ends. The center distance between the bearings is 160 mm. A load of 300 N acts vertically downwards at 60 mm distance from the left hand bearing whereas a load of 550 N acts horizontally at 50 mm distance from the right hand bearing. Shaft speed is 3000 r.p.m and expected life of the bearings is 7000 hrs. With a reliability of 95 %. It is intended to use same bearing at both ends of the shaft. Calculate dynamic load rating of the bearing so that it can be selected from manufacturer's catalogue. Take service factor as 1.75 and inner race is rotating. **(10)**

OR

b) A single row deep groove ball bearing operated with the following work cycle if the expected life of the bearing is 13000 hrs with reliability of 90 % calculate the dynamic load rating of the bearing and determine reliability of a system consisting of four such bearings. The work cycle is **(10)**

Table.

Expt. no	Element Time	Fr KN	Fa KN	Radial Factor	Thrust Factor	Race Rotating	Cs	Speed rpm
1	30%	5	1.5	0.56	1.1	Inner	1.25	960
2	40%	3.7	0.73	0.56	1.3	Outer	1.4	1440
3	50%	-	-	-	-	outer	-	720

Q.5 **a)** The following data is given for a 360^0 hydrodynamic bearing. **(10)**

Radial load = 10 KW
Journal speed = 1450r.p.m
l/d ratio = 01
bearing length = 50 mm
radial clearance = 20 micron
eccentricity = 15 micron
specific gravity of lubricant = 0.86
specific heat of lubricant = 2.09 KJ/Kg^0c

Calculate:

1. The minimum oil film thickness.
2. The coefficient of friction
3. The power lost in friction.
4. The viscosity of lubricant in cp
5. The total flow rate of lubricant in l/min
6. The side leakage.

Table.

Refer the data table from [**Q. No.5 B**].

...2...

OR

b) Design a full hydrodynamic journal bearing with following specification for machine tool application. **(10)**

Journal diameter = 75 mm
Radial load = 10 KN
Journal speed = 1440 r.p.m
Minimum oil film thickness 22.5 microns.
Inlet temperature = 40^0 c
Bearing material = babbit
Determine the length of the bearing and select suitable oil for this application. Take permissible bearing pressure for machine tool application 2 $N/mm^2$for standard value of radial clearance in case of babbit material
c = 0.0375 mm and ho = 0.0225 mm
refer Table.

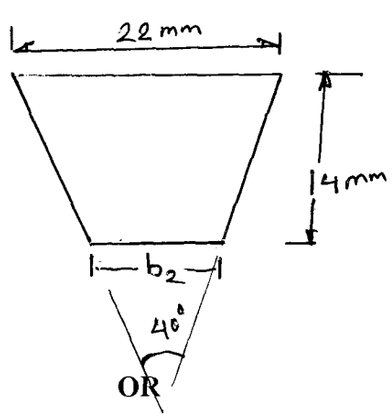
$\frac{P\max}{p}$	l/d	ho/c	∈	S	$\frac{r}{c}f$	$\frac{Q}{r.c.ns.l}$	$\frac{Q_s}{Q}$
4.048	1	0.1	0.9	0.0188	1.05	4.74	0.919
3.195		0.2	0.8	0.0446	1.70	4.62	0.842
2.409		0.4	0.6	0.121	3.22	4.33	0.680
2.066		0.6	0.4	0.264	5.79	3.99	0.497
1.890		0.8	0.2	0.631	12.8	3.59	0.280

Q.6 **a)** The following data is given for a V belt drive connecting a 20 KW motor to a compressor. **(10)**

Parameter	Motor pulley	Compressor Pulley
Pitch circle diameter mm	300	900
Speed r.p.m	1440	480
Coefficient of friction	0.2	0.2

The relative distance between pulley is 1m and the dimensions of the cross section of the belt are given in figure. The density of the composite belt is 0.97 g/cc and the allowable tension per belt is 850 N. How many belts are required for this application?

Diagram:



OR

b) Write down the advantages, limitations and applications of chain drive. **(10)**

* * * * *