Registration no: ⬜⬜⬜⬜⬜⬜⬜⬜⬜⬜

Total Number of Pages: 03   **B.TECH**
                                                                                  PME5D002

5ᵗʰ Semester Regular Examination – 2017-18
DESIGN OF MACHINE COMPONENTS
Branch : MECH
Time: 3 Hours
Max marks: 100
Q Code: B488

Answer Question No.1 and 2 which are compulsory and any four from the rest.
The figures in the right hand margin indicate marks.Draw neat sketches wherever necessary. Assume any missing data suitably. Use of Prescribed Design Data Book is permitted inside the examination hall.

Q1 **Answer the following questions:**   **(2 x 10)**

a) In case of a single plate clutch, six springs are used for
    i) avoiding spring failure ii) distributing axial load uniformly iii) reducing the size of the spring iv) none of the above.

b) Self locking is not possible in case of
    i) simple band brake ii) differential band brake iii) simple block brake Iv) internal expanding shoe brake.

c) Whipping stress is also known as
    i) cerippling stress ii) stress due to transverse loading iii) stress due to reciprocating mass intertia iv) none of the above.

d) The design of piston crown is based on
    i) strength and rigidity ii) rigidity and heat transfer iii) heat transfer iv) strength and heat trasfer.

e) Surface hardness of the gear material is helpful in
    i) static mode design ii) dynamic mode design iii) wear mode design iv) all of the above

f) If both the pinion and gear are made of same material, then the load transmission capacity is decided by
    i) the gear ii) the pinion iii) both (a) and (b) iv) none of the above.

g) The crowing of a flat belt pulley is done to avoid
    i) slipping of a belt ii) running off the belt iii) creep of the belt iv) wearing out of the belt

h) The type of clutch used on motors with low starting torque is i) single plate clutch ii) cone clutch iii) multiple plate clutch iv) centrifugal clutch.

i) A small length of the connecting rod results into
    i) small obliquity and small side thrust ii) small obliquity and large side thrust iii) large obliquity and small side thrust iv) large obliquity and large side thrust.

j) Some procedure of finite element method are
    i) _____of domain ii) _____of an interpolation model iii) _____of characteristics matrix.

Q2   **Answer the following questions:**   **(2 x 10)**

    a) What is the effect of piston crown thickness and diameter on heat flow? And how the wear of the piston rings prevented?

    b) Why one end of the connecting rod is bigger than the other end?

    c) What do you understand by unform pressure theory and uniform wear teory with respect to design of a friction clutch? Which theory is most suitable for design of clutch plate?

    d) What is the impotance of boundary conditions in a finite element problem?

    e) Why in case of thin cylinder subjected to internal pressure, the tangential stress is the criteria for determine the thickness of the cylinder wall?

    f) What is the functional difference between a brake and a clutch?

    g) Describe the steps, which you will be considering for design for crank pin?

    h) What do you mean by virtual or formative bevel gear?

    i) Why Cast Iron is preffered as the gear material?

    j) What types of crank shafts are commonly used?

Q3 **a)** Design a closed cylindrical pressure vessel with dish end closures which is required to contain air at a pressure of 4.25MPa. The shell is 420 mm inside diameter. The joint is double welded butt joint having joint effiency 75%. The vessel is made of plain carbon steel having allowable strength 100 N/mm^2. The shape factor is 1.07. Design the pressure vessel.   **(8)**

    b) In a spring-loaded Hartnell governor, the weight of each ball is 25 N and the ball arm attains vertical position at the speed of 450 rpm. The length of the ball arm and the sleeve arm are 150 mm and 100 mmrespectively. The distance between the pivot of the lever and the axis of rotation is 125 mm. Design the lever if the speed is to be limited to 5% for a lift of 20 mm.   **(7)**

Q4 **a)** Describe the working principle of centrifugal clutch.   **(5)**

    b) Design a suitable clutch for the speed gear box of a lathe machine to transmit 12.5 kW at 1250 rpm. Due to space limitation, the outer diameter is limited to 140 mm. Select axial friction clutch with woven asbestos friction lining having co-efficient of friction as 0.25. The maximum operating temperature is limited to 250^0. Take overload as 25%. Maximum pressure at inner radius is 0.35 N/mm^2. Allowable bearing pressure is within the range of 0.3 to 0.7 N/mm^2. The ratio of inner diameter to outer diameter is 0.6.   **(10)**

Q5 **a)** Describe with the help of neat sketch the principles of operation of an internal expanding shoe brake.   **(5)**

    b) A machine is driven at 1500 rpm by means of a flat belt. The pulleys on the motor and machine shafts are of 250 mm and 800 mm diameter respectively. Design the belt for transmitting 25 kW power.   **(10)**

Q6   Design a pair of helical gears to transmit 25 kW power at a speed reduction ratio of 4:1. The input shaft rotates at 1500 rpm. Take helix and normal pressure angles equal to 25^0 and 20^0 respectively. Both   **(15)**

pinion and gear are made of steel having following data. The number of teeth on the pinion may be taken as 30.

Name of the part	Permissible stress	BHN
Pinion	50 MPa	350
Gear	45 MPa	310

Young's modulus for shaft, gear and pinion is 0.2×10^6 N/mm^2. The gears are required to be designed against bending failure of the teeth under dynamic condition. The wear and lubrication factor is 1.25 and velocity factor is 0.46. Face width is 15 times normal module. Profile error is 0.015. Assume other suitable data.

Q7 Design a connecting rod for a carburettor engine from the following data: **(15)**

Diameter of piston is 100 mm, weight of the reciprocating part is 1.75 kg, length of the connecting rod is 315 mm, stroke is 140 mm, speed is 2500 rpm, compression ratio is 4:1 and maximum explosion pressure is 2.25 MPa. Material for the connecting rod is 37Mn2 with yield strength 450 N/mm^2. Allowable bearing pressure is 12N/mm^2. Material for the bolt is 35Ni1Cr60 having allowable tensile strength 120 N/mm^2. Gasket factor is 0.2. Assume other suitable data.

Q8 Design a flywheel for a single-cylinder, four stroke vertical cylinder diesel engine developing 4.5 kW at 1250 rpm. Assume coefficient of speed fluctuation as 0.01 and coefficient of fluctuation of energy as 2.35. The flywheel is made of grey cast iron having limiting speed 25 m/sec. The mass of the rim is 90% of the total mass and remaining 10% is contributed by web and hub. The width to thickness ration of the rim cross section is 1.5. Density of the rim material is 7100 kg/m^3 and the width to thickness ratio of rim is 1.5. The flywheel is fixed to an overhang shaft. The length of the overhang is 250 mm. Assume allowable shear stress for the crankshaft and key as 50 MPa and for cast iron in tension as 20 MPa. The combined shock and fatigue factors for tension and bending may be taken as 1.2 and 1.5 respectively. **(15)**

Q9 a) Derive the element characteristics matrix for a one-dimentional line element using the quadratic interpolation fuction. **(10)**

b) What is the effect of mesh size on the accuracy of soultion for the mechanical design component? **(2.5)**

c) What is meant by whipping of a connecting rod and what is its effect? **(2.5)**