Reg. No. : 2 1 1 5 1 1 1 1 4 0 1 5

**Question Paper Code : 31569**

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Fifth Semester

Mechanical Engineering

ME 2303 / ME 53 / 10122 ME 504 — DESIGN OF MACHINE ELEMENTS / MACHINE DESIGN

(Regulation 2008 / 2010)

(Common to Fifth Semester, Automobile Engineering, Fourth Semester – Manufacturing Engineering, Industrial Engineering and Management and Industrial Engineering)

(Common to PTME 2303 — Design of Machine Elements for B.E. (Part-Time) Fourth Semester Mechanical Engineering – Regulation 2009)

Time : Three hours Maximum : 100 marks

Note : Approved Design Data Book is permitted to use in the examination.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Describe the material properties of hardness, stiffness and resilience.

2. What are the methods used to improve fatigue strength?

3. A shaft of 70mm long is subjected to shear stress of 40 MPa and has an angle of twist equal to 0.017 radian. Determine the diameter of the shaft. Take $G = 80\ GPa$.

4. What is the main use of woodruff keys?

5. State the two types of eccentric welded connections.

6. What is a gib? Why is it provided in a cotter joint?

7. A helical spring of rate 12 N/mm is mounted on the top of another spring of rate 8 N/mm. Find the force required to give a deflection of 50mm.

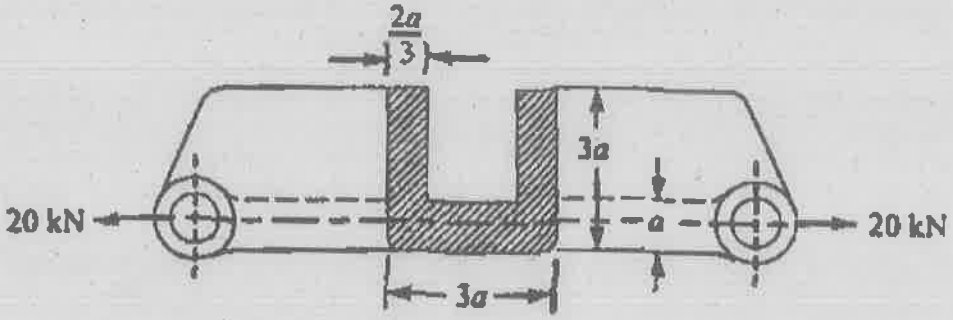
8. What is the purpose of flywheel that is used in an IC engine?

9. What is meant by life of anti- friction bearings?

10. What are the essential requirements in an end face seal?

PART B — (5 × 16 = 80 marks)

11. (a) A cast-iron link, as shown in figure, is to carry a load of 20 kN. If the tensile and compressive stresses in the link are not to exceed 25 MPa and 80 MPa respectively, obtain the dimensions of the cross- section of the link at the middle of its length. (16)




Or

(b) A hot rolled steel shaft is subjected to a torsional moment that varies from 330 Nm clockwise to 110 Nm counter clockwise and an applied bending moment at a critical section varies from 440 Nm to -220 Nm. The shaft is of uniform cross- section and no keyway is present at the critical section. Determine the required shaft diameter. The material has an ultimate strength of 550 MPa and yield strength of 410 MPa. Take the endurance limit as half the ultimate strength, factor of safety of 2, size factor of 0.85 and a surface finish factor of 0.62. (16)

12. (a) A hoisting drum 0.5 m in diameter is keyed to a shaft which is supported in two bearings and driven through a 12:1 reduction ratio by an electric motor. Determine the power of the driving motor, if the maximum load of 8 kN is hoisted at a speed of 50 m/min and the efficiency of the drive is 80%. Also determine the torque on the drum shaft and the speed of the motor in r.p.m. Determine also the diameter of the shaft made of machinery steel, the working stresses of which are 115 MPa in tension and 50 MPa in shear. The drive gear whose diameter is 450 mm is mounted at the end of the shaft such that it overhangs the nearest bearing by 150mm. The combined shock and fatigue factors for bending and torsion may be taken as 2 and 1.5 respectively. (16)

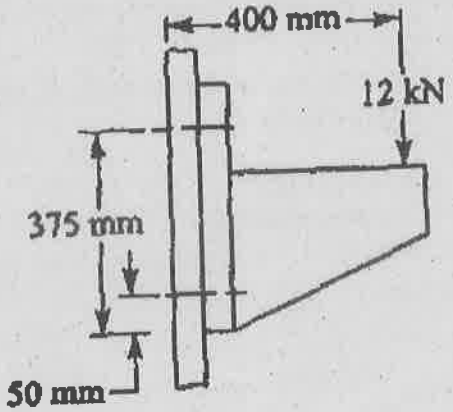
Or

(b) Design a rigid flange coupling to transmit a torque of 250 Nm between two co-axial shafts. The shaft is made of alloy steel, flanges out of cast iron and bolts out of steel. Four bolts are used to couple the flanges. The shafts are keyed to the flange hub. The permissible stresses are given below :

| | | |
|---|---|---|
| Shear stress on shaft | = | 100 MPa |
| Bearing or crushing stress on shaft | = | 250 MPa |
| Shear stress on keys | = | 100 MPa |
| Bearing stress on keys | = | 250 MPa |
| Shearing stress on cast iron | = | 200 MPa |
| Shearing stress on bolts | = | 100 MPa |

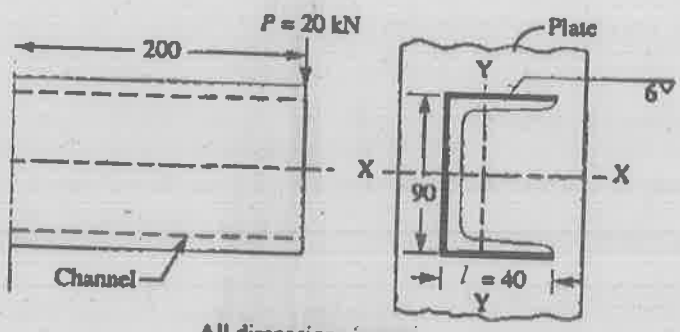
After designing the various elements, make a neat sketch of the assembly indicating the important dimensions. The stresses developed in the various members may be checked if thumb rules are using for fixing the dimensions. (16)

13. (a) For supporting the travelling crane in a workshop, the brackets are fixed on steel columns as shown in figure. The maximum load that comes on the bracket is 12 kN acting vertically at a distance of 400 mm from the face of the column. The vertical face of the bracket is secured to a column by four bolts, in two rows (two in each row) at a distance of 50 mm from the lower edge of the bracket. Determine the size of the bolts if the permissible value of the tensile stress for the bolt material is 84 MPa. Also find the cross- section of the arm of the bracket which is rectangular. (16)




Or

(b) Find the maximum shear stress induced in the weld of 6 mm size when a channel, as shown in figure, is welded to a plate and loaded with 20 kN force at a distance of 200 mm. (16)




All dimensions in mm.

14. (a) A helical compression spring made of oil tempered carbon steel is subjected to a load which varies from 400 N to 1000 N. The spring index is 6 and the design factor of safely is 1.25. If the yield stress in shear is 770 MPa and endurance stress in shear is 350 MPa, find: (i) Size of the spring wire, (ii) Diameter of the spring. (iii) Number of turns of the spring, and (iv) Free length of the spring. The compression of the spring at the maximum load is 30 mm. The modulus of rigidity for the spring material may be taken as 80 kN/mm$^2$. (16)

Or

(b) A single cylinder double acting steam engine delivers 185 kW at 100 r.p.m. The maximum fluctuation of energy per revolution is 15 percent of the energy developed per revolution. The speed variation is limited to 1 percent either way from the mean. The mean diameters of the rim are 2.4 m. Design and draw two views of the flywheel. (16)

15. (a) Design a journal bearing for a centrifugal pump for the following data: Load on the journal = 20000 N; Speed of the journal= 900 r.p.m.; Type of oil is SAE 10, for which the absolute viscosity at 55°C = 0.17 N/m-s; Ambient temperature of oil = 15.5°C; Maximum bearing pressure for the pump = 1.5 N/mm$^2$. Calculate also mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited to 10°C. Heat dissipation coefficient = 1232 W/m$^2$/°C. (16)

Or

(b) Determine the dimensions of an I- section connecting rod for a petrol engine from the following data:

| | | |
|---|---|---|
| Diameter of the piston | = | 110 mm |
| Mass of the reciprocating parts | = | 2kg |
| Length of the connecting rod from centre to centre | = | 325 mm |
| Stroke length | = | 150mm |
| R.P.M. | = | 1500 with possible over speed of 2500 |
| Compression ratio | = | 4 :1 |
| Maximum explosion pressure | = | 2.5 N/mm$^2$. |

(16)

Reg. No. : | | | | | | | | | | | | |

**Question Paper Code : 21569**

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2013.

Fifth Semester

Mechanical Engineering

ME 2303/ME 53/10122 ME 504 – DESIGN OF MACHINE ELEMENTS/ MACHINE DESIGN

(Common to Fifth Semester, Automobile Engineering, Fourth Semester – Manufacturing Engineering, Industrial Engineering and Management and Industrial Engineering)

(Regulation 2008/2010)

(Common to PTME 2303 – Design of Machine Elements for B.E. (Part-Time) Fourth Semester Mechanical Engineering — Regulation 2009)

Time : Three hours Maximum : 100 marks

Note: Approved Design Data Book is permitted to use in the examination.

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are unilateral and bilateral tolerances?
2. What are the various theories of failure?
3. What is the main use of woodruff keys?
4. Name any two of the rigid and flexible couplings.
5. Define the term self locking of power screws.
6. Write any two advantages and disadvantages of welded joints over riveted joints.
7. What is surge in springs?
8. Define Co-efficient of fluctuation of speed in flywheel.
9. What is meant by journal bearing?
10. What do you mean by life of an individual bearing?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Explain various phases in Design using a flow diagram and enumerate the factors influencing the machine design. (12)

(ii) What is meant by hole basis system and shaft basis system? Which one is preferred and why? (4)

Or

(b) (i) What is the difference between Gerber curve and soderberg and Goodman lines? (6)

(ii) A machine component is subjected to fluctuating stress that varies from 40 to 100 N/mm$^2$. The corrected endurance limit stress for the machine component is 270 N/mm$^2$. The ultimate tensile strength and yield strength of material are 600 and 450 N/mm$^2$ respectively. Find the factor of safety using :

(1) Gerber theory

(2) Soderberg line

(3) Goodman line and

(4) Also, find factor of safety against static failure. (10)

12. (a) A steel solid shaft transmitting 15 kW at 200 rpm is supported on two bearings 750 mm apart and has two gears keyed to it. The pinion having 30 teeth of 5 mm module is located 100 mm to the left of the right hand bearing and delivers power horizontally to the right. The gear having 100 teeth of 5 mm module is located 150 mm to the right of the left hand bearing and receives power in a vertical direction from below. Using an allowable stress of 54 MPa in shear. Determine the diameter of the shaft. (16)

Or

(b) A rigid type of coupling is used to connect two shafts transmitting 15 kW at 200 rpm. The shaft, keys and bolts are made of C45 steel and the coupling is of cast iron. Design the coupling. (16)

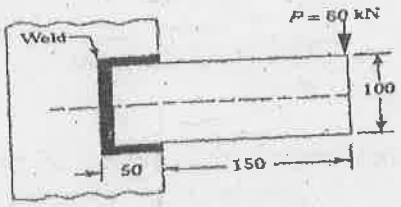
13. (a) Design and draw a cotter joint to support a load varying from 30 kN in compression to 30 kN in tension. The material used is carbon steel for which the following allowable stresses may be used. The load is applied statically.

Tensile stress = Compressive Stress = 50 MPa, Shear stress = 35 MPa and Crushing Stress = 90 MPa. (16)

Or

(b) (i) What is an eccentric loaded welded joint? Describe procedure for designing such a joint. (8)

(ii) A rectangular steel plate is welded as a cantilever to a vertical column and supports a single concentrated load P, as shown in figure. Determine the weld size if shear stress in the same is not to exceed 140 MPa. (8)




All dimensions in mm

14. (a) A safety valve of 60 mm diameter is to blow off at a pressure of 1.2 N/mm$^2$. It is held on its seat by a close coiled helical spring. The maximum lift of the valve is 10 mm. Design a suitable compression spring of spring index 5 and providing an initial compression of 35 mm. The maximum shear stress in the materials of the wire is limited to 500 MPa. The modulus of rigidity for the spring material is 80 kN/mm$^2$ calculate :

(i) Diameter of the spring wire,

(ii) Mean coil diameter,

(iii) Number of active turns,

(iv) Pitch of the coil. (16)

Or

(b) A machine punching 38 mm holes in 32 mm thick plate requires 7 N-m of energy per sq. mm of sheared area, and punches one hole in every 10 seconds. Calculate the power of the motor required. The mean speed of the flywheel is 25 meters per second. The punch has a stroke of 100 mm. find the mass of the flywheel required, if the total fluctuation of speed is not to exceed 3% of the mean speed. Assume that the motor supplies energy to the machine at uniform rate. (16)

15. (a) Design a journal bearing for 12 MW, 1000 rpm steam turbine, which is supported by two bearings. Take the atmospheric temperature as 16°c and operating temperature of oil as 60°C. Assume viscosity of oil as 23 Ns/m$^2$. (16)

Or

(b) Select a suitable deep groove ball bearing for supporting a radial load of 10 KN and an axial load of 3 KN for a life of 4000 hours at 800 rpm. Select from series 63. Calculate the expected life of the selected bearing. (16)

Reg. No. | | | | | | | | | | | | |

**Question Paper Code : 51856**

**B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016**

**Fifth Semester**

**Mechanical Engineering**

**ME 2303/ME 53/10122 ME 504 – DESIGN OF MACHINE ELEMENTS / MACHINE DESIGN**

**(Common to Fifth Semester, Automobile Engineering and Mechanical and Automation Engineering, Fourth Semester – Manufacturing Engineering, Industrial Engineering and Management and Industrial Engineering)**

**(Regulations 2008/2010)**

**(Common to PTME 2303 – Design of Machine Elements for B.E. (Part-Time) Fourth Semester – Mechanical Engineering – Regulations – 2009)**

**Time : Three Hours** **Maximum : 100 Marks**

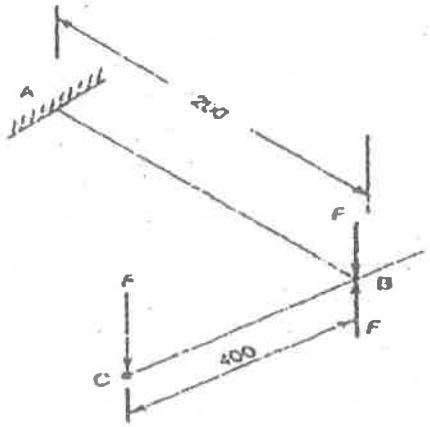
**Use of approved data book permitted**
**Answer ALL questions.**

**PART – A (10 × 2 = 20 Marks)**

1. Define limits and fits.
2. What is an adaptive design ?
3. Why a hollow shaft has greater strength and stiffness than solid shaft of equal weight ?
4. Under what circumstances flexible couplings are used ?
5. State the two types of eccentric welded connections.
6. What is a gib ? Why is it provided in a cotter joint ?
7. What is stiffness of spring ?
8. What is nipping of leaf spring ?
9. What is meant by journal bearing ?
10. What do you mean by life of an individual bearing ?

## PART – B (5 × 16 = 80 Marks)

11. (a) The shaft of an overhang crank is subjected to a force F of 2 kN as shown in fig. below. The shaft is made of 30 $Mn^2$ steel having a allowable shear strength equal to 100 $N/mm^2$. Determine the diameter of the shaft. **(16)**




**OR**

(b) Design a muff coupling to connect two steel shafts transmitting 25 kW power at 360 rpm. The shafts and key are made of plain carbon steel 30 C8 ($S_{yt}$ = $S_{yc}$ = 400 $N/mm^2$). The sleeve is made of grey cast iron FG 200 ($S_{ut}$ = 200 $N/mm^2$). The factor of safety for the shafts and key is 4. For the sleeve, the factor of safety is 6 based on ultimate strength. **(16)**

12. (a) A horizontal nickel steel shaft rests on two bearings, A at the left and B at the right end and carries two gears C and D located at distances of 250 mm and 400 mm respectively from the centre line of the left and right bearings. The pitch diameter of the gear C is 600 mm and that of gear D is 200 mm. The distance between the centre line of the bearings is 2400 mm. The shaft transmits 20 kW at 120 rpm. The power is delivered to the shaft at gear C and is taken out at gear D in such a manner that the tooth pressure $F_{tc}$ of the gear C and $F_{tD}$ of the gear D act vertically downwards.

Find the diameter of the shaft, if the working stress is 100 MPa in tension and 56 MPa in shear. The gear C and D weighs 950 N and 350 N respectively. The combined shock and fatigue factors for bending and torsion may be taken as 1.5 and 1.2 respectively. **(16)**

**OR**

(b) Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 r.p.m. The overall torque is 20 percent more than mean torque. The material properties are as follows :

(i) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively

(ii) The allowable shear stress for cast iron is 15 MPa;

(iii) The allowable bearing pressure for rubber bush is 0.8 $N/mm^2$

(iv) The material of the pin is same as that of shaft and key.

Draw neat sketch of the coupling. **(16)**

13. (a) A rectangular steel plate 100 mm wide is welded to a vertical plate to form a cantilever with an overlap of 50 mm and an overhang of 150 mm. It carries a vertical downward load of 60 kN at free end. Fillet weld is done three sides of the plate for a permissible stress of 140 $N/mm^2$. Determine the size of the weld. **(16)**

**OR**

(b) A knuckle joint is to transmit a force of 140 kN. Allowable stresses in tension, shear and compression are 75 $N/mm^2$, 65 $N/mm^2$ and 140 $N/mm^2$ respectively. Design the joint. **(16)**

14. (a) A helical compression spring made of oil tempered carbon steel is subjected to a load which varies from 400 N to 1000 N. The spring index is 6 and the design factor of safely is 1.25. If the yield stress in shear is 770 MPa and endurance stress in shear is 350 MPa, find: (i) Size of the spring wire, (ii) Diameter of the spring, (iii) Number of turns of the spring, and (iv) Free length of the spring. The compression of the spring at the maximum load is 30 mm. The modulus of rigidity for the spring material may be taken as 80 $kN/mm^2$. **(16)**

**OR**

(b) A single cylinder double acting steam engine delivers 185 kW at 100 r.p.m. The maximum fluctuation of energy per revolution is 15 percent of the energy developed per revolution. The speed variation is limited to 1 percent either way from the mean. The mean diameters of the rim are 2.4 m. Design and draw two views of the flywheel. **(16)**

15. (a) Design a journal bearing for 12 MW, 1000 rpm steam turbine, which is supported by two bearings. Take the atmospheric temperature as 16 °C and operating temperature of oil as 60 °C assume viscosity of oil as 23 $Ns/m^2$. **(16)**

**OR**

(b) Select a suitable deep groove ball bearing for supporting a radial load of 10 kN and an axial load of 3 kN for a life of 4000 hours at 800 rpm. Select from series 63. Calculate the expected life of the selected bearing. **(16)**

Reg. No. : | | | | | | | | | | | | |

**Question Paper Code : 11529**

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2012.

Fifth Semester

Mechanical Engineering

ME 2303/ME 53/10122 ME 504 — DESIGN OF MACHINE ELEMENTS

(Common to Automobile Engineering)

(Regulation 2008)

(Common to PTME 2303 — Design of Machine Elements for B.E. (Part-Time) Fourth Semester Mechanical Engineering — Regulation 2009)

Time : Three hours Maximum : 100 marks

Note : Approved Design Data Book is permitted to use in the examination.

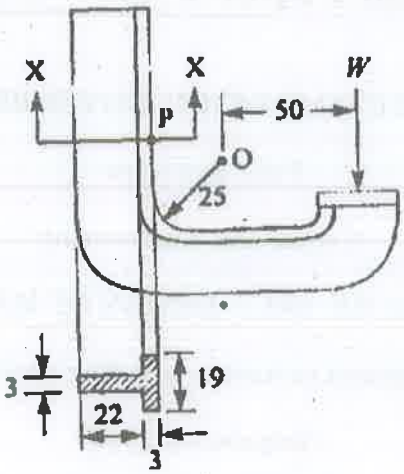
Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is 'Adaptive design? Where is it used? Give examples.
2. State the difference between straight beams and curved beams.
3. Why a hollow shaft has greater strength and stiffness than solid shaft of equal weight?
4. Under what circumstances flexible couplings are used?
5. Define the term self- locking of power screws.
6. What are the possible modes of failure of riveted joint?
7. Write the formula for natural frequency of spring.
8. How does the function of flywheel differ from that of governor?
9. Explain the term Dynamic load carrying capacities of rolling contact bearing.
10. What type of external forces act on connecting rod?

PART B — (5 × 16 = 80 marks)

11. (a) A C- clamp is subjected to a maximum load of W, as shown in figure. If the maximum tensile stress in the clamp is limited to 140 MPa. Find the value of load $W$. (16)




Section of X-X

All dimensions in mm

Or

(b) A pulley is keyed to a shaft midway between two bearings. The shaft is made of cold drawn steel for which the ultimate strength is 550 MPa and the yield strength is 400 MPa. The bending moment at the pulley varies from -150 N-m to + 400 N-m as the torque on the shaft varies from -50 N-m to + 150 N-m. Obtain the diameter of the shaft for an indefinite life. The stress concentration factors for the keyway at the pulley in bending and in torsion are 1.6 and 1.3 respectively. Take the following values: Factor of safety = 1.5; Load correction factors = 1.0 in bending, and 0.6 in torsion; Size effect factor = 0.85; Surface effect factor = 0.88. (16)

12. (a) A horizontal nickel steel shaft rests on two bearings, A at the left and B at the right end and carries two gears C and D located at distances of 250 mm and 400 mm respectively from the centre line of the left and right bearings. The pitch diameter of the gear C is 600 mm and that of gear D is 200 mm. The distance between the centre line of the bearings is 2400 mm. The shaft transmits 20 kW at 120 rpm. The power is delivered to the shaft at gear C and is taken out at gear D in such a manner that the tooth pressure $F_{tC}$ of the gear C and $F_{tD}$ of the gear D act vertically downwards.

Find the diameter of the shaft, if the working stress is 100 MPa in tension and 56 MPa in shear. The gear C and D weighs 950 N and 350 N respectively The combined shock and fatigue factors for bending and torsion may be taken as 1.5 and 1.2 respectively. (16)

Or

(b) Design a bushed- pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 r.p.m. The overall torque is 20 percent more than mean torque. The material properties are as follows :

(i) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively

(ii) The allowable shear stress for cast iron is 15 MPa,

(iii) The allowable bearing pressure for rubber bush is 0.8 N/mm$^2$

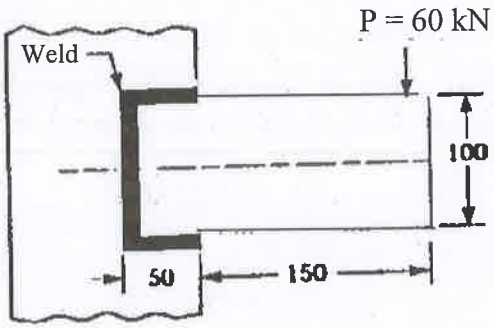
(iv) The material of the pin is same as that of shaft and key.

Draw neat sketch of the coupling. (16)

13. (a) Design a knuckle joint to transmit 150 kN. The design stresses may be taken as 75 MPa in tension, 60 MPa in shear and 150 MPa in compression. (16)

Or

(b) A rectangular steel plate is welded as a cantilever to a vertical column and supports a single concentrated load P, as shown in figure Determine the weld size if shear stress in the same is not to exceed 140 MPa. (16)




All dimensions in mm

14. (a) Design a helical spring for a spring loaded safety valve (Ramsbottom safety valve) for the following conditions: Diameter of valve seat = 65mm; Operating pressure = 0.7 N/mm$^2$ ; Maximum pressure when the valve blows off freely = 0.75 N/mm$^2$ ; Maximum lift of the valve when the pressure rises from 0.7 to 0.75 N/mm$^2$ = 3.5 mm ; Maximum allowable stress = 550 MPa; Modulus of rigidity = 84 kN/mm$^2$ ; Spring index = 6. (16)

Or

(b) Design a cast iron flywheel used for a four stroke I.C engine developing 180 kW at 240 r.p.m. The hoop or centrifugal stress developed in the flywheel is 5.2 MPa, the total fluctuation of speed is to be limited to 3% of the mean speed. The work done during the power stroke is 1/3 more than the average work done during the whole cycle. The maximum torque on the shaft is twice the mean torque. The density of cast iron is 7220 kg/m$^3$. (16)

15. (a) (i) Select a suitable deep groove ball bearing for supporting a radial load of 10 kN and an axial load of 3 kN for a life of 4000 hrs at 800 r.p.m. Select from series 63. Calculate the expected life of the selected bearing. (8)

(ii) A journal bearing 150 mm diameter and 300 mm long carries a radial load of 9 kN at 1200 rpm. The diametral clearance is 0.075 mm. If 6 kW is being lost in friction, what is the viscosity of the oil used at given operating temperature? (8)

No tes

Or

(b) Design a suitable connection rod for a petrol engine for the following details. Diameter of the piston = 100 mm; Weight of reciprocating parts per cylinder = 20 N ; connecting rod length = 300 mm; Compression ratio = 7:1 ; Maximum explosion pressure = 3 N/mm² ; Stroke = 140 mm; speed of the engine = 2000 r.p.m. (16)

Notes

Reg. No. | | | | | | | | | | | | |

**Question Paper Code : 57566**

**B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016**

**Fifth Semester**

**Mechanical Engineering**

**ME 6503 – DESIGN OF MACHINE ELEMENTS**

**(Regulations 2013)**

**(Common to B.E. Automobile Engineering, Mechanical and Automation Engineering, Industrial Engineering and Mechatronics Engineering)**

**Time : Three Hours** **Maximum : 100 Marks**

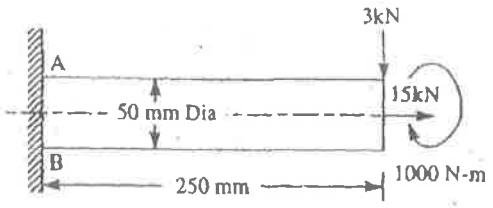
**Note : Use of Approved Design Data Book is permitted.**
**Any required design data can be suitably assumed**
**Answer ALL questions.**

**PART – A (10 × 2 = 20 Marks)**

1. Describe the material properties of hardness, stiffness and resilience.
2. Define stress concentration.
3. What is the effect of key ways cut into the shaft ?
4. Differentiate between rigid coupling and flexible coupling.
5. What are the stresses act on screw fastenings due to static loading ?
6. What are the two types of fillet weld ?
7. Define spring rate.
8. Define the term 'fluctuation of speed' and 'fluctuation of energy'.
9. What is meant by hydrodynamic lubrication ?
10. What are the advantages of Rolling Contact Bearings over Sliding Contact Bearings ?

## PART – B (5 × 16 = 80 Marks)

11. (a) A shaft, as shown in Fig, is subjected to a bending load of 3 kN, pure torque of 1000 N-m and a'n axial pulling force of 15 kN. Calculate the stresses at A and B. **(16)**




**All dimensions in mm.**

**OR**

(b) A steel cantilever is 200 mm long. It is subjected to an axial load which varies from 150 N (compression) to 450 N(tension) and also a transverse load at its free end which varies from 80 N up to 120 N down. The cantilever is of circular cross-section. It is of diameter 2d for the first 50mm and of diameter'd' for the remaining length. Determine its diameter taking a factor of safety of 2. Assume the following values:

Yield stress = 330Mpa; Endurance limit in reversed loading = 300Mpa

Correction factors = 0.7 in reversed axial Loading

= 1.0 in reversed Bending

Stress concentration factor = 1.44 for bending

= 1.64 for axial loading

Size effect factor = 0.85; Surface effect factor = 0.90;

Notch sensitivity index = 0.90 **(16)**

12. (a) A solid steel shaft is supported on two bearings 1.8 m apart and rotates at 250 r.p.m. A 20° involute gear D, 300 mm diameter is keyed to the shaft at a distance of 150 mm to the left on the right hand bearing. Two pulleys B and C are located on the shaft at distances of 600 mm and 1350 mm respectively to the right of the.left hand bearing. The diameters of the pulleys B and C are 750 mm and 600 mm respectively. 30 kW is supplied to the gear, out of which 18.75 kW is taken off at the pulley C and 11.25 kW from pulley B. The drive from B is vertically downward while from C the drive is downward at an angle of 60° to the horizontal. In both cases the belt tension ratio is 2 and the angle of lap is 180°. The combined fatigue and shock factors for torsion and bending may be taken as 1.5 and 2 respectively. Design a suitable shaft taking working stress to be 42 MPa in shear and 84 MPa in tension. **(16)**

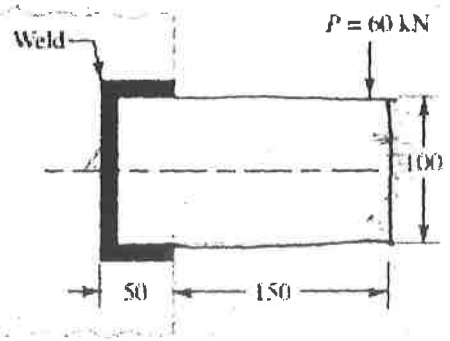
**OR**

(b) Design and draw a protective type of cast iron flange coupling for a steel shaft transmitting 15 kW at 200 r.p.m. and having an allowable shear stress of 40 MPa. The working stress in the bolts should not exceed 30 MPa. Assume that the same material is used for shaft and key and that the crushing stress is twice the value of its shear stress. The maximum torque is 25% greater than the full load torque. The shear stress for cast iron is 14 MPa. **(16)**

13. (a) A steam engine of effective diameter 300 mm is subjected to a steam pressure of 1.5 N/mm$^2$. The cylinder head is connected by 8 bolts having yield point 330 MPa and Endurance limit at 240 MPa. The bolts are tightened with an initial preload of 1.5 times the steam load. A soft copper gasket is used to make the joint leak-proof. Assuming a factor of safety 2, find the size of bolt required. The stiffness factor for copper gasket may be taken as 0.5 . **(16)**

**OR**

(b) A rectangular steel plate is welded as a cantilever to a vertical column and supports a single concentrated load P, as shown in Fig. Determine the weld size if shear stress in the same is not to exceed 140 MPa. **(16)**




14. (a) A safety valve of 60 mm diameter is to blow off at a pressure of 1.2 N/mm$^2$. It is held on its seat by a close coiled helical spring. The maximum lift of the valve is 10 mm. Design a suitable compression spring of spring index 5 and providing an initial compression of 35 mm. The maximum shear stress in the material of the wire is limited to 500 MPa. The . modulus of rigidity for the spring material is 80 kN/mm$^2$.

Calculate: 1. Diameter of the spring wire, 2. Mean coil diameter,

3. Number of active turns, and 4. Pitch of the coil. **(16)**

**OR**

(b) A punching press pierces 35 holes per minute in a plate using 10kN-m of energy per hole during each revolution. Each piercing takes 40 per cent of the time needed to make one revolution. The punch receives power through a gear reduction unit which in turn is fed by a motor driven belt pulley 800 mm diameter and turning at 210 r.p.m. Find the power of the electric motor if overall efficiency of the transmission unit is 80 per cent. Design a cast iron flywheel to be used with the punching machine for a coefficient of steadiness of 5, if the space considerations limit the maximum diameter to 1.3 m.

Allowable shear stress in the shaft material = 50 MPa,

Allowable tensile stress of cast iron= 4 MPa,

Density of cast iron = 7200 kg/m$^3$. **(16)**

15. (a) Design a journal bearing for a centrifugal pump from the following data : Load on the journal = 20 000 N; Speed of the journal = 900 r.p.m.; Type of oil is SAE JO, for which the absolute viscosity at 55°O 0.017 kg/m-s; Ambient temperature of oil = 15.5°C; Maximum bearing pressure for the pump = 1.5 N/mm2. Take the diameter of the journal as 100 mm and length to diameter ratio as 1.6.Calculate also mass of the lubricating oil required for artificial cooling, if rise of temperature of oil be limited to 10°C. Heat dissipation coefficient = 1232 W/m2/°C. **(16)**

**OR**

(b) Select a single row deep groove ball bearing for a radial load of 4000 N and an axial load of 5000 N, operating at a speed of 1600 r.p.m. for an average life of 5 years at 10 hours per day. Assume uniform and steady load. Take 300 working days per year. **(16)**