Design of Spur Gears (Tute. Sheet-1)

1. Why involute gears are more commonly used as compared to the cycloidal gears? Discuss briefly
2. Explain the phenomenon of interference in involute gears. How is it avoided?
3. Write short note on Gear manufacturing methods and Gear tooth profiles
4. Explain the different causes of gear tooth failures and suggest possible remedies to avoid such failures.
5. What do you understand by beam strength & wear strength of gear tooth?

2007-08

1. A pair of 20° stub teeth spur gears is to transmit 20 kW. The pinion rotates at 500 rpm and the velocity ratio is 1 : 4. The allowable static stresses for gear and pinion materials 100 MPa and 120 MPa respectively. The pinion has 20 teeth and the face width is 10 times the module. Design the gear for static strength.

2008-09

1. A pair of straight teeth spur gears is to transmit 25 kW when the pinion rotates at 300 rpm. The velocity ratio is 1:3. The allowable static stresses for the pinion and gear materials arc 120 MPa and 100 MPa respectively. The pinion has 15 teeth and its face width is 15 times the module. Determine module, face width and pitch circle diameters of pinion and the gear from the standpoint of strength only, taking into consideration the effect of the dynamic loading. Assume 20° full depth involute pairs with ordinary cutting.

2009-2010

1. A pair of straight teeth spur gears, having 20° involute full depth teeth is to transmit 15 kW at 300 rpm of the pinion. The speed ratio is 3:1. Assume number of teeth on pinion is to be 16 with a face width of 14 times module., Surface endurance limit of gears is 600 MPa. Assuming the steady load conditioni and 8-10 hours of service per day, determine the module, face width and pitch diameter of gears. Given

	Gear (CI)	Pinion (steel)
Allowable static stress	60 Mpa	105 Mpa
Modulus of elasticity	100 kN/mm^2	200 kN/mm^2

2. A compressor running at 250 rpm is driven by a 15 kW, 1000 rpm motor through a 14.5° full depth gears. The centre distance is 375 mm. The motor pinion is to be of C-30 forged steel hardened and tempered, and driven gear is to be of cast steel. Assuming medium shock conditions, determine the module, face width and the number of teeth on each gear.

2010-1 I

1. A 20 degree full depth pinion drives a gear and transmits 11.25 kW at 1200 rpm. The observed data are : m= 5mm. , t=24 , face wid.th=50mm. The gears are made of same steel with BHN of 300. Check the gears for strength and wear.
2. A Bakelite pinion is used to transmit power 400 rpm. The module is 10 mm and the pitch diameter is 0.25m and the face width is 0,127m. The teeth are 20^0 standard involute. Determine (i) number of teeth, circular pitch and outside diameter of pinion (ii) the power the pinion should transmit for smooth intermittent service and.(iii) the power for continuous service.

2011-12

1. A pair of spur gear with 20° full depth involute teeth has pinion with 24 teeth and gear with 72 teeth. The pinion speed is 3000 rpm and it transmits 35 kW. The permissible static bending stress for the material of both the gears is 140 MPa. Design the gear.

Design of Spur Gears (Tute. Sheet-1)

2. Two parallel shafts with center distance 200 mm are to be connected by 20° full depth spur gear and pinion for a speed ratio of 3 : 1. The speed of the pinion is 600 rpm. Module and width of the gear and pinion are 5 mm and 50 mm respectively. The safe static stresses for pinion and gear are 110 and 55 MPa respectively. Find maximum power that can be transmitted safely.

2012-13

1. A pair of spur gears is to be designed as per Lewis equation. Pinion is rotating at 1000 rpm meshes with a gear; with speed reduction of 3. Power to be transmitted is 12 kW. Starting torque of electric motor supplying power to pinion is 150% of the rated torque. The gears are made of steel with allowable bending stress is 200 MPa. Face width can be taken as 10 m. Where m is the module. Taking factor of safety of 2, determine the module and gear sizes. Specify surface hardness of gears

2. A pair of spur gears with 20° full depth involute teeth needs to be designed. input shaft rotates at 800 rpm and receives a 6 kW power. Speed reduction of output shaft is by 5 times. The gears are made of steel with a. = 450 MPa Service factor is 1.3 and the face width is ten times of the module. The gears are machined to accuracy of Grade 8. Assume a pitch line velocity of 3.6 ms⁻', factor of safety 2 and deformation factor 11.4 GPa. Estimate the module of the gear teeth. Determine the dynamic load by using Buckirigham's equation.

2013-14

1. A pair of 20° full depth straight teeth spur gears is to transmit 25 kW. The pinion rotates at 400 rpm and the velocity ratio is 4:1. The allowable static stresses for gear and pinion materials are 100 MPa and 120 MPa respectively. The Pinon has 16 teeth and face width is 12 times the module. Design the gear for static strength.
2. A Bakelite pinion is used to transmit power at 1440 r.p.m. The module is 10 mm and pitch diameter is 0.25 in and face width is 0.127 m. The teeth are 20° standard involute. Determine :
   - **(i)** Number of teeth, circular pitch and outside diameter of pinion.
   - **(ii)** The power for smooth intermittent service.
3. Design a spur gear drive required to transmit 45 kW at a pinion speed 800 rpm, the velocity ratio is 3:1. The teeth are 20° full depth involute with 18 teeth on pinion. The pinion and gear are made of steel;

2014-15

1. A bronze spur pinion rotating at 600 rpm. Drives cast iron spur gear at transmission ratio of 4:1. The allowable static stresses for the bronze pinion and cast iron gear are 84 MPa and 105MPa respectively. The pinion has 16 standard 20° full depth involute teeth of module 8 mm, The face width of both the gears is 90 mm, Find the power that can be transmitted from the standpoint of strength.

2015-16

1. 20-tooth, 8 pitch, 2.54-mm-wide, 20° pinion transmits 5 kw at 1725 rpm to a 60-tooth gear. Determine driving force, separating force, and resultant force that would act on mounting shafts.
2. A pair of straight teeth spur gears is to transmit 25 kW when pinion rotates at 300 rpm. 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 15 times the module. Determine the module, face width and pitch circle diameters of both the pinion and the gear from standpoint of strength only, taking into consideration the effect of d amic loading. Assume 20° full depth involute pairs with ordinary cutting.
3. A steel pinion with 20° full depth involute teeth is transmitting 7.5 kW power at 1000 rpm from an electric motor. The starting torque of the motor is twice the rated torque. The number of teeth on the pinion is 25, while the module is 4. The face width 45 mm. Assuming that velocity factor accounts for the dynamic load, calculate
   - Effective load on the gear tooth
   - Bending stress in the gear tooth.
4. A pair of 20° stub teeth spur gears is to transmit 20 kW . The pinion rotates at 500 rpm and the V.R. is 1 : 4. The allowable static stress for gear and pinion are 100 Mpa and 120 Mpa respectively. The pinion has 20 teeth and face width is 10 times the module. Design the gear for static strength

2016-17

5. A bronze spur pinion rotating at 600 r.p.m. drives a cast iron spur gear at a transmission ratio of 4: 1. The allowable static stresses for the bronze pinion and cast iron gear are 84 MPa and 105 MPa respectively. The pinion has 16 standard 20° full depth involute teeth of module 8 mm. The face width of both the gears is 90 mm. Find the power that can be transmitted from the standpoint of strength.

Design of Helical gears (Tute. Sheet-2)

1. Write a short note on lubrication of gears.
2. What are the disadvantages of spur gears? How these difficulties are overcome in helical gears?
3. Give the terminology of helical gears with suitable diagram.
4. What is herringbone helical gear?
5. Discuss the classification of helical gears. With a neat sketch explain the forces acting on a helical gear and explain the formative number of teeth.

2007-08

1. A pair of helical gears is used to transmit 20 kW at 5000 rpm of the pinion. The teeth are 20° stub in diametral plane and the helix angle is 35°. The pinion has a pitch circle diameter of 80 mm and gear ratio is 4 : 1. Both gear and pinion are made of cast steel with an allowable static strength of 100 MPa. Suggest a suitable module and face width for the gear pair and check the strength of the design in wear. Take modulus of elasticity for cast steel as 2 x 10' MPa and s_{es} = 620 N/mm^2

2008-09

1. Design a pair of helical gears of equal diameter, 20° stub tooth helical gears to transmit 40 kW with moderate shock at 1200 rpm. The two shafts are parallel and 45 cm apart. Find the module and face width of the teeth.

2009-2010

1. Design a pair of parallel helical gears made of 20 teeth pinion meshing with a (15) 100 teeth gear. The pinion rotates at 720 rpm. The normal pressure angle is 20^0 while the helix angle is 25°. The face width is 40 mm and the normal module is 4 mm. The pinion as well as gear is made of steel with ultimate strength of 600 N/mm^2 and heat treated to a surface hardness of 300 BHN. The service factor and the factor of safety are 1.5 and 2 respectively.

2010-1I

1. A 56 kW motor running at 450 rpm is geared to a pump by means Of a helical gearing. The C30 forged step pinion on the motor shaft is 200 mm in diameter and drives a good grade cast iron gear on the pump shaft at 120 rprn. Determine the module and the face width.

2011-12

1. Two precision cut forged steel helical gears have 20° full depth involute teeth. The helix angle is 23° and permissible static bending stress is 100 MPa. If gear ratio is 3 : 1, module is 3 mm, face width is 300 mm and surface endurance strength is 630 MPa; find the power transmitted and wear load and state whether the design is safe. The speed of pinion is 600 rpm.

2012-13

2. A pair of helical gears transmits 5 kW. The following are its details : Teeth on pinion = 25, teeth on gear 50, normal module 4 mm, helix angle 20° and normal pressure angle =20°. Determine the axial, tangential and radial components of the tooth load if pinion rotates at 1200 rpm.
3. A pair of helical gears consists of25 teeth pinion meshing with 100 teeth gear. Normal pressure angle is 20° and helix angle is 25°. The pinion rotates at 740 rpm. Normal module of gear is 5 mm and face width is 50 mm. Both pinion and gear are made of steel with allowable bending strength of 330 MPa. Gears are heat treated to a surface hardness of 380 BHN. What power can be transmitted by gears if service factor is 1.3 ? Assume velocity factor accounts for the dynamic load.

2014-15

1. A pair of helical gears is to transmit 15 kW. The teeth are 20° stub in diametral plane and have a helix angle of 45°. The pinion runs at 10000 rpm. And has 80 mm pitch diameter. The gear has 320 mm pitch diameter. If the gears are made of cast steel having allowable static strength of 100 MPa; determine a suitable module and face width from static strength considerations and check the gears for wear, given Ses=618Mpa

2015-16

2. A pair of helical gears is used to transmit 15 kW at 3000 rpm of the pinion. The teeth are 20° stub in diametric plane and the helix angle is 45°. The gear and pinion have a pitch diameter of 320 and 80 mm respectively. Both the gears are made of cast steel with an allowable stress of 100 Mpa. The modulus of elasticity for cast steel is 2 x 10^5 Mpa and its surface endurance strength is 618 MPa. Suggest a suitable module and face width for gear pair and check the strength of the gear pair in wear.
3. The following data is given for a pair of parallel helical gears made of steel : Power transmitted = 20 kW, n_p = 720 rpm, z_p = 35, zg = 70, centre distance = 285 mm, normal module = 5 mm, b = 50 mm, normal pressure angle = 20°, S. = 600 N/mm^2, surface hardness number = 300 BEN, grade of machining = 6, Service factor = 1.25 Calculate: The helix angle; Beam strength, Wear strength, Static load

2016-17

1. A pair of helical gears is to transmit 15 kW. The teeth are 20° stub in diametral plane and have a helix angle of 45°. The pinion runs at 10 000 r.p.m. and has 80 mm pitch diameter. The gear has 320 mm pitch diameter. If the gears are made of cast steel having allowable static strength of 100 MPa; determine a suitable module and face width from static strength considerations and check the gears for wear, given σes = 618 MPa

Design of Bevel Gears (Tute. Sheet-3)

1. Give the terminology of bevel gears with suitable diagram
2. Short note on Formative number of teeth for a bevel gear and Forces acting on the bevel gear tooth

2007-08

1. A 20^{o} full depth straight teeth bevel gear rotates at 500 rpm and transmits 12 kW power to other gear rotating at 200 rpm. The outer module is 3.5 mm and the number of teeth on pinion is 30. Ratio between the cone distance and face width is 3. Check the safety of design for steady loading if allowable static stress in bending is 100 MPa.

2009-2010

1. Design two C.I bevel gears having pitch diameter of 7.5 cm and 10 cm respectively are to transmit 2 kW at 1100 rpm of the pinion. The teeth profiles are 14-^{1} system. Assume light shock load conditions with 8-10 hours per day service.

2016-17

1. A pair of 20º full depth involute teeth bevel gears connect two shafts at right angles having velocity ratio 3 : 1. The gear is made of cast steel having allowable static stress as 70 MPa and the pinion is of steel with allowable static stress as 100 MPa. The pinion transmits 37.5 kW at 750 r.p.m. Determine: a) Module and face width; b) Pitch diameters; and c) Pinion shaft diameter. Assume tooth form factor,

$$y = 0.154 - \frac{0.912}{T_E},$$

Where TE is the formative number of teeth, width = 1/3 rd the length of pitch cone, and pinion shaft overhangs by 150 mm.

Extra

1. 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 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.

Design of Worm Gears (Tute. Sheet-4)

1. Using a suitable schematic diagram explain the forces acting on worm gears. Also, define normal pitch, helix angle and efficiency of worm gear drive.
2. Derive the expression for efficiency of worm wheel drive
3. What is the importance of center distance in the design of worm and worm gear.
4. What kind of contact occurs between worm and worm wheel? How does it differ from other types of gears?

2007-08

1. A worm gear has 30 teeth of 142_2 and the coefficient of friction for worm gear is 0.05. The worm is triple threaded with a module of 6 mm and pitch circle diameter of 50 mm. Calculate the following :
   - **(i)** Lead angle of worm
   - **(ii)** Velocity ratio
   - **(iii)** Center distance
   - **(iv)** Efficiency of gearing

2008-09

2. Design a worm gearing to transmit 10 kW from an electric motor running at 1500 rpm to a machine running at 75 rpm. Load is intermittent (< 3 hr. of continuous service) and steady.

2009-2010

3. Design a worm gear set to transmit 12 kW from a shaft rotating at 1400 rpm to another at 75 rpm. Assume normal pressure angle as 20° and centre distance between the shafts is 25 cm.

2010-1 I

4. Design a worm drive for a speed reducer to transmit 30 kW at a worm speed of 600 rpm. The desired velocity ratio is 25:1 and an efficiency of at least 87% desired. Assume the worm and gear are made of hardened steel,

2011-12

5. Design a worm and worm gear drive for a speed reduction by 25. Worm rotates at 600 rpm and transmits 35 kW. Assume double start thread and gear has 50 full depth 20° involute teeth.

2012-13

1. A pair of worm gear is designated as 2/55/10/5. The worm rotates at 750 rpm and normal pressure angle is 20°. Worm is made of case hardened steel, and the gear of phosphor-bronze and worm set is well lubricated. Determine the power lost due to friction when power input is I kW.

2013-14

2. A worm gear has 30 teeth of 14'/2° and the coefficient of friction for worm gear is 0.05. The worm is triple threaded with a module of 6 mm and pitch circle diameter of 50 mm. Calculate the following :
   - (i) Lead angle of worm
   - (ii) Velocity ratio
   - (iii) Center distance
   - (iv) Efficiency of gearing

2014-15

3. Design 20° involute worm and gear to transmit 10 kW with worm rotating at 1400 rpm. and to obtain a speed reduction of 10:1 The distance between the shafts is 225 mm.
4. A double threaded worm drive is required for power transmission between two shafts having their axes at right angles to each other. The worm has $14^1/_2°$ involute teeth. The centre distance is approximately 200 mm. If the axial pitch of the worm is 30 mm and lead angle is 23°, find (i) lead; (ii) Pitch circle diameter of worm and worm gear; (iii) Helix angle of the worm; and (iv) efficiency of the drive if the coefficient of friction is 0.05.

2015-16

1. Design a high efficiency worm gear speed reducer to transmit continuously the rated power output of 15 kW motor running at 1750 rpm. The steel worm having hardness 250 BHN is integral with the motor shaft. The speed ratio is 10, while the phosphor bronze gear should not have less than 40 mm.

2016-17

1. A worm drive transmits 15 kW at 2000 r.p.m. to a machine carriage at 75 r.p.m. The worm is triple threaded and has 65 mm pitch diameter. The worm gear has 90 teeth of 6 mm module. The tooth form is to be 20° full depth involute. The coefficient of friction between the mating teeth may be taken as 0.10. Calculate: 1. tangential force acting on the worm; 2. axial thrust and separating force on worm; and 3. efficiency of the worm drive.

Design of Sliding Contact Bearings (Tute. Sheet-5)

1. What are journal bearings? Give a classification of these bearings and discuss them briefly
2. Differentiate between "Hydro-dynamic lubrication"; "Wedge-film lubrication" and "squeeze-film lubrication".
3. Write short note on the lubricants used in sliding contact bearings.
4. What are stable and unstable lubrications? Explain with the help of bearing characteristic number.
5. Explain the following terms as applied to journal bearing: (i) Bearing characteristic number; and (ii) Bearing modulus
6. Write Short note on Materials used for sliding contact bearings and Variation of coefficient of friction with bearing modulus

2007-08

1. A full journal bearing of 50 mm diameter and 100 mm length has a bearing pressure of 1.4 N/mm^2. The speed of the journal is 900 rpm and the ratio of journal diameter to the diametral clearance is 1000. The lubricating oil used has absolute viscosity at operating temperature of 75°Ur 0.011 kg/m-s. The room temperature is 35°. Determine the amount of artificial cooling required and the mass of lubricating oil required if the difference between the outlet and inlet temperature of the oil is 10°. Take specific heat of oil is 1850 J/kg/°C.

2008-09

7. Design a journal bearing for a centrifugal pump from the following data:

Load on the journal = 20 kN

Speed of the journal = 1000 rpm

Absolute viscosity of oil at 55°C = 0.017 kg/m-s Ambient temperature of oil = 16°C Maximum bearing pressure for the Pump = 1.5 N/mm^2

2010-1 I

1. A sleeve bearing 50 mm diameter and 50mm long has a journal speed of 3000 rpm. The radial load on the bearing is 5.5 kN. The oil used is SEA10 at an average temperature of ar. If the ratio of raigimum film thickness to diametral clearance is 03, determine radial clearance, heat loss and minimum film thickness.
2. Design a journal bearing fora centrifugal pump. The she ft diameter is 150 mm and 'length to diameter ration is 1.6 and the load on the bearing is 40 kb;. The speed *of* shaft is I 500 rpm.

2011-12

1. A full journal bearing of diameter 80 mm and length 120 mm is to support a load of 20 kN at the shaft speed of 1500 rpm. The bearing temperature is to be limited to 75° and the ambient room temperature is 38°. The viscosity of oil used is 0.0088 kg/m-s at 115°. Check if artificial cooling is required and find the amount of artificial heating.
2. Design a journal bearing to support a load of 5 kN at 1000 rpm using a hardened steel journal and bronze backed babbit bearing. The bearing is lubricated by oil rings. Assume room temperature as 25° and the oil temperature as 77°.

2012-13

1. Following data is given for a full hydrodynamic bearing :

Radial load = 22 kN, journal speed = 960 rpm, unit pressure in bearing = 2.4 MPa, viscosity of lubricant = 20 cP, ratio of length to diameter= I and ratio of minimum film thickness to clearance = 0.2. Determine : (i) dimensions of the bearing, (ii) minimum film thickness and (iii) requirements of oil flow.

2. The following data is given for a 360° hydrodynamic bearing :

Length to diameter ratio = 1, Journal speed = 1350 rpm, Journal diameter =100 mm. diametral clearance = 100 Am, external load = 9 kN. The value of minimum film thickness variable is 0.3. Find the viscosity of lubricating oil used.

2013-14

1. Design a bearing to support a load of 5.5 kN at 650 rev/min using a hardened steel journal and babbitt bearing. The bearing is lubricated by the oil rings. Take room temperature as 22° C and the oil temperature as 85° C.
2. A turbine shaft running at 1800 r.p.m has a diameter of 300 mm. The load on the bearing due to shaft is 180 kN. Determine the length of the bearing if the allowable bearing pressure is 1.6 N/mm^2. Also find the amount of heat removed by the lubricant per minute, if the bearing temperature is 60° C and viscosity of the oil is 0.02 kg/m-s and the bearing clearance is 0.25 mm.

Design of Sliding Contact Bearings (Tute. Sheet-5)

2014-15

1. Design a journal bearing for a centrifugal pump running at 1440 rpm, The diameter of the journal is 100 and load on each bearing is 20 kN. The factor ZN/p may be taken as 28 for centrifugal pump bearings. The bearing is running at 75°C. temperature and the atmosphere temperature is 30°C. The energy dissipation coefficient is 875 $W/m^2/°C$. Take diametral clearance as 0.1 mm,
2. A journal bearing with a diameter of 200 mm and length 150 mm carries a load of 2OkN, when the journal speed is 150 rpm. The diametral clearance ratio is 0.0015. If possible, the bearing is temperature at 35°C ambient temperature without external cooling with a maximum oil temperature of 90°C If external cooling is required, it is to be as little as possible to minimize the required oil flow rate and heat exchanger size.

   (i) What type of oil do you recommend?

   (ii) Will the bearing operate without external cooling?

   (iii) If the bearing operates without external cooling, determine the operating oil temperature.

   (iv) If the bearing operates with external cooling, determine the amount of oil in kg/min required to carry away the excess heat generated over heat dissipated, when the oil temperature rises from 85°C to 90°C, when passing through the bearing

2015-16

1. A journal bearing has a journal diameter of 50 mm and the diameter of bushing is 50.1 mm. The bushing is 50 mm long and has to support a load of 1 ICN at a speed of 1200 rpm. Determine the minimum oil film thickness and power loss for SAE 10 oil, assuming the oil film temperature to be 70°C.

2016-17

1. A 80 mm long journal bearing supports a load of 2800 N on a 50 mm diameter shaft. The bearing has a radial clearance of 0.05 mm and the viscosity of the oil is 0.021 kg / m-s at the operating temperature. If the bearing is capable of dissipating 80 J/s, determine the maximum safe speed.
2. The thrust of propeller shaft is absorbed by 6 collars. The rubbing surfaces of these collars have outer diameter 300 mm and inner diameter 200 mm. If the shaft runs at 120 r.p.m., the bearing pressure amounts to 0.4 N/mm^2. The coefficient of friction may be taken as 0.05. Assuming that the pressure is uniformly distributed, determine the power absorbed by the collars.
3. A full journal bearing of 50 mm diameter and 100 mm long has a bearing pressure of 1.4 N/mm^2. The speed of the journal is 900 r.p.m. and the ratio of journal diameter to the diametral clearance is 1000. The bearing is lubricated with oil whose absolute viscosity at the operating temperature of 75°C may be taken as 0.011 kg/m-s. The room temperature is 35°C. Find: 1. The amount of artificial cooling required, and 2. The mass of the lubricating oil required, if the difference between the outlet and inlet temperature of the oil is 10°C. Take specific heat of the oil as 1850 J / kg / °C.

Design of Rolling contact Bearings (Tute Sheet-6)

1. Enumerate the advantages and disadvantages of rolling contact bearings

2. What are the main components of the rolling contact bearing?

3. Define the following terms as applied to rolling contact bearings:
(i) Basic static load rating (ii) Static equivalent load (iii) Basic dynamic load rating (iv) Dynamic equivalent load.

4. How do you express the life of a bearing? What is an average or median life?
5. Explain reliability of antifriction bearings.

6. Derive the following expression as applied to rolling contact bearings subjected to variable load cycle

$$W_e = \sqrt[3]{\frac{N_1 (W_1)^3 + N_2 (W_2)^3 + N_3 (W_3)^3 + \ldots}{N_1 + N_2 + N_3 + \ldots}}$$

W_e = Equivalent cubic load,

W_1, W_2 and W_3 = Loads acting respectively for N_1, N_2, N_3 ...

2007-08

1. A bearing is required for a 35 mm shaft. It is to operate for 8 hours per day, 5 days per week for 5 years and is to carry a stationary radial load of 2250 N at 1500 rpm. The inner race rotates. There is possibility of light shock. Suggest a suitable bearing.

2008-09

1.Select a single row deep groove ball bearing for a radial load of 4 kN and an axial load of 5 kN, operating at a speed of 1500 rpm for an average life of 5 years at 10 hrs. per day. Assume uniform and steady load.

2009-2010

1. Select single row deep groove ball bearing for a radial load of 4 kN and an axial load of 5 kN, operating at a speed of 1600 rpm for an average life of 5 years at 10 hours per day. Assume uniform and steady load.

2010-1 I

2.Select a single row deep groove ball bearing for a radial load of 4.5 kN and axial load of 6 kN, operating .speed of 1500 rpm for an average life of 5 years at 10 hours per day under uniform and steady load condition.
3.Find the rated life of a 60 mm bore, light series ball bearing under a 6000 N radial load at 600 rpm. The bearing rotates with the inner rings. There is no shock loading..

2011-12

1.A deep groove ball bearing has dyntimic capacity of 20000 N and is to operate on the following work cycle; Radial load of 6000 N at 200 rpm for 25% time, radial load of 9000 N at 500 rpm for 20% of the time and radial load of 3500 N at 400 rpm for the remaining period. Assuming the loads are steady and the inner race rotates, find the average expected life of the bearing in hours.

2. Select a suitable bearing for a 40 mm shaft that has to operate 8 hours per day, 5 days per week for 5 years and is to carry a stationary radial load 2500 N at 1500 rpm. The use involve minor shock and inner ring is rotating.

2012-13

1. For a single row deep groove ball bearing, dynamic load carrying capacity of the bearing is 5590 N and static load carrying capacitS' of the bearing g is 2500 N. Axial and radial load on the bearing are 625 N and 1250 N respectively. Determine the equivalent load and life of ball bearing if (i) inner race is rotating and (ii) outer race is rotating.
2. A system is using 3 identical ball bearings, each subjected to 3 kINI radial load. Reliability of the system that is I out of 3 bearings failing during the life time of 6 million cycles is 83%. Determine the dynamic load carrying capacity of the bearing with 90% reliability.

2013-14

1. Select a single row deep groove ball bearing for a radial load of 4500 N and axial load of 55,000 N operating at speed of 1500 rpm for an average life of 5 years running for 12 hours per day.
2. Select a suitable roller bearing to carry a radial load of 25,000 N. The shaft rotates at 1500 rpm, average life is 4000 hours. Inner race rotates. Take mild shock.

2014-15

1. A shaft rotating at constant speed is subjected to variable load. The bearings supporting the shaft are subjected to stationary equivalent radial load of 3 kN for 10 per cent of time, 2 KN for 20 per cent of time, 1 kN for 30 per cent of time and no load for remaining time of cycle. If the total life expected for the beating is 20 x 106 revolutions at 95 per cent reliability, calculate dynamic load rating of the bearing.

2. Select a single row deep groove ball bearing for radial load of 4000 N and an axial load of 5000 N, operating at speed of 1600 rpm. for an average life of 5 years at 10 hour per day. Assume uniform and steady load.

2016-17

1. A shaft rotating at constant speed is subjected to variable load. The bearings supporting the shaft are subjected to stationary equivalent radial load of 3 kN for 10 per cent of time, 2 kN for 20 per cent of time, 1 kN for 30 per cent of time and no load for remaining time of cycle. If the total life expected for the bearing is 20X 10^6 revolutions at 95 per cent reliability, calculate dynamic load rating of the ball bearing.

Design of IC Engine Parts- (Tute-7)

Explain the following in brief

1. Why I section is chosen for high speed IC engines?
2. Lubrication of small end bearing and crank pin bearing of connecting rod.
3. Two most usual causes of failure of crank shafts
4. Different types of piston rings
5. Stresses induced in a connecting rod.
6. Material and manufacturing of crankshaft
7. Design considerations of piston
8. Selection of type of IC engine
9. Valve gear mechanism of IC engine
10. Effect of piston crown thickness and diameter on heat flow,
11. Lubrication of piston rings,
12. Stress induced in connecting rod
13. Why piston is made light weight?
14. What is SAE?
15. What is the purpose of valve spring?
16. Explain the various types of cylinder liners.
17. Explain the various forces induced in the connecting rod.
18. What is the function of a connecting rod of an internal combustion engine?

2007-08

1. Determine the cross section of I section connecting rod for a single cylinder IC engine. Following data are provided for the engine :

    i. Piston diameter = 100 mm
    ii. mass of reciprocating parts = 2.25 kg
    iii. length, of connecting rod = 300 mm
    iv. stroke length = 125 mm
    v. speed = 1500 rpm
    vi. maximum explosion pressure = 3.5 N/mm^2
    vii. factor of safety = 7
    viii. density of rod material = 8000 kg/m^3
    ix. yield stress in compression = 330 MPa Assume width of section as 4t and depth as 5t, where t is the web thickness of I section.

2. A cast iron piston for single acting four stroke engine for the following applications :

    Cyliner bore = 100 mm
    Stroke = 120 mm
    maximum gas pressure ---- 5 N/mm^2
    break mean effective pressure = 0.65 N/mm^2
    fuel consumption = 0.227 kg/k W/h
    Speed = 2200 rpm

    Find the suitable thickness of the piston head.Thermal conductivity for cast iorn is 460 J/s m^2 °c/m and allowable temperature difference is 222°C.

2008-09

1. Design a connecting road for 4 stroke petrol engine, with the following data:

    Piston diameter = 0.10 m stroke length = 0.15 m
    Length of connecting rod (centre to centre) = 0.30 m
    Weight of reciprocating parts = 20 N
    Speed is 1500 rpm with possible overspeed of 2500 rpm
    Compression ratio — 4:1
    Maximum Explosion pressure = 2.5 MPa

1. Design a piston for a single acting four stroke engine for the following specifications

    cylinder bore. = 0.30 m Stroke length = 0.375 m
    Maximum gas pressure = 8 MPa

Brake mean effective pressure = 1.15 MPa

Fuel consumption ---- 0.22 kg/kW/hr.

Speed = 500 rpm

Assume suitable data.

2009-2010

2. A 4 stroke diesel engine has the followikg specifications

Brake power = 5 kW

Speed = 1200 rpm

Indicated mean effective 0.35 N/mm^2 Pressure

Mechanical efficiency 80%

Determine the bore and length of the cylinder and thickness of cylinder head

3. A four stroke IC engine is developing 50 kW power at 2200 rpm for which a connecting rod is required to be designed for the following data :

Piston diameter = 90 mm

Mass of reciprocating parts = 1.5 kg

Length of connecting rod between the two centres = 300 mm

Stroke length = 125 mm

Approximate compression ratio = 6.8 : 1

Maximum explosion pressure shortly after dead centre = 3.5 N/mm^2

2010-1 I

4. Design an aluminium alloy piston for a single acting four stroke engine for the following specifications :

Cylinder bore = 0.30 m

Stroke = 0.375m

Maximum gas pressure = MPa

Brake mean effective pressure - 1.15 MPa Fuel consumption 0.22 kg/kWihr

Speed = 500 rpm

4. A four stroke petrol *engine* has following data :

Piston diameter = 100 trim

Stroke Length 150 mm

Length of connecting rod = 315 mm

Weight of reciprocating parts, = 18,2 N

Speed — 1500 rpm

Compression ratio — 4

Maximum explosion pressure — 2:40 MPa

Determine the size of rod cross section, dimensions of big and small ends of the connecting rod and size-of bolts for big end,

2011-12

5. The cylinder of a slow speed steam engine is 250 mm diameter and the steam pressure 1 N/mm^2. The piston rod length is 1000 mm and the connecting rod is 1.2 m long. The engine stroke is 550 nun. Determine the dimensions of the cross section of the connecting rod assuming the depth to be twice as thickness and a suitable diameter for the piston rod.

6. A four stroke diesel engine has the following specifications :

Brake power : 12 kW

Speed : 1500 rpm

Indicated MEP : 0.35 N/mm^2

Mechanical efficiency: 80%

Determine :

(i) bore and length of the cylinder,

(ii) thickness of the cylinder head, and size of stud for the cylinder head

2012-13

1. Design a crank shaft of a single cylinder petrol engine with following specifications :

Shaft material 60C4, for which permissible stress in bending and compression can be taken as 60 MPa and 75 MPa respectively.

Maximum gas pressure on piston = 2.5 MPa,

Cylinder bore = 95 mm,

L/R ratio = 4.5 (Where L is the length of connecting rod and R is crank radius),

Design of IC Engine Parts- (Tute-7)

For crank pin : L/d =1, allowable bearing pressure =13 MPa. For main bearings: L/d =1.5, where d = crank pin diameter and allowable pressure in main bearing = 7 MPa.

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

2. The cylinder of a four stroke diesel engine has the following specifications :
   Cylinder bore : 150 mm
   The maximum pressure: 3.5 MPa
   Cylinder material Grey cast iron FG 200 (S = 200 MPa)
   Factor of safety is : 6
   Poisson's ratio: 0.25

Determine the thickness oft& cylinder wall. Also calculate the apparent and net circumferential stresses in the cylinder wall.

2013-14

3. Design an aluminium alloy piston for a single acting four stroke engine, for the following specification :
   Cylinder bore = 0.40 m; Break mean effective pressure = 2.5 MPa
   Stroke = 0.480 m ; Fuel consumption = 0.36 kg/ kW/hr
   Maximum gas pressure = 10 MPa ; Speed = 900 r.p.m
4. Design a connecting rod for 4 stroke petrol engine with the following data :
   Piston diameter = 0.20 m
   Stroke length = 0.30 m
   Length of connecting rod (centre to centre) = 50 m
   Weight of reciprocating parts = 50 N
   Speed is 1440 r.p.m with possible overspeed of 3 000 r.p.m
   compression ratio = 3:1
   Maximum explosion pressure = 3 MPa

2014-15

5. A four stroke diesel engine has the following specifications :
   Brake power = 5 kW; Speed = 1200 rpm; Indicated mean effective pressure=0.35 N/mm^2; Mechanical efficiency=80%.
   Determine: 1. Bore and length of the cylinder; 2 thickness of the cylinder head; and Size of studs for the cylinder head.
6. Design a cast iron for a single acting four stroke engine for the following data : Cylinder bore=100 mm; Stroke = 125 mm; Maximum gas pressure=5 N/mm^2; Indicated mean effective pressure=0.75 N/mm^2; Mechanical efficiency=80%; Fuel consumption = 0.15 kg per brake power per hour; Higher calorific value if fuel=42 x 103 kJ/kg; Speed=2250 rpm.
   Any other data required for the design may be assumed.

2015-16

7. The bore of a cylinder of the four stroke diesel engine is 150 mm. The maximum gas pressure inside the cylinder is limited to 3.5 Mpa. The cylinder head is made of grey cast iron FG 200 (out = 200 N/mm2) and the FOS is 5 .Determine the thickness of the cylinder head .Studs is made of steel FeE 250 (oyt = 250 N/mm2) and the FOS is 5. Calculate :
   Number of studs
   Nominal diameter of studs Pitch of stud
8. Determine the dimensions of cross-sections of the connecting rod (1-section), for a diesel engine with the following data :
   Cylinder bore = 100 mm
   Length of connecting rod = 320 mm
   Maximum gas pressure = 2.45 Mpa
   FOS against buckling failure = 5

2016-17

9. A four stroke diesel engine has the following specifications:
   Brake power = 5 kW; Speed = 1200 r.p.m. ; Indicated mean effective pressure = 0.35 N / mm^2; Mechanical efficiency = 80 %.
   Determine: 1. bore and length of the cylinder; 2. thickness of the cylinder head ; and 3. size of studs for the cylinder head.
10. Design a cast iron piston for a single acting four stroke engine for the following data:
   Cylinder bore = 100 mm ; Stroke = 125 mm ; Maximum gas pressure = 5 N/mm^2 ; Indicated mean effective pressure = 0.75 N/mm^2 ; Mechanical efficiency = 80% ; Fuel consumption = 0.15 kg per brake power per hour ; Higher calorific value of fuel = 42 × 10^3 kJ/kg ; Speed = 2000 r.p.m. Any other data required for the design may be assumed.