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**DHANALAKSHMI SRINIVASAN COLLEGE OF ENGINEERING AND TECHNOLOGY**

**Mamallapuram, Chennai-603104.**

**DEPARTMENT OF MECHANICAL ENGINEERING**

**QUESTION BANK**

### Subject Code: ME8651 Year/Semester: III /06

### Subject Name: Design of Transmission Systems

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| **UNIT I –DESIGN OF FLEXIBLE ELEMENTS** | |
| Design of Flat belts and pulleys - Selection of V belts and pulleys – Selection of hoisting wire ropesand  pulleys – Design of Transmission chains and Sprockets. | |
| **PART \* A** | |
| **Q.No.** | **Questions** |
| 1 | **Give an expression for ratio of tensions in a flat belt drive.** BTL3  𝑇1 = 𝑒𝜇𝜃  𝑇2  Where, T1=Tension in tight side in N; T2=Tension in slack side in N; µ=Coefficient of friction; θ=Angle of contact of driving pulley in radians. |
| 2 | **How is a V-belt specified?**BTL2  A typical example of its specification “C2032 IS 2494: 1964”. Here the ‘C’ denotes the section type of the belt, ‘2032’ represents the nominal inside length of the belt and 1964 is referred to as year of coding. The power transmitting capacity of section’C’ type of the belt is 1 kW to 12 kW. |
| 3 | **What is meant by “Chordal action of chain”? Also name a company that produces driving chains. (April/May 2015)** BTL1  When chain passes over a sprocket, it moves as a series of chords instead of a continuous arc as in the case of a belt drive. It results in varying speed of the chain drive. This phenomenon is known as chordal action. Some of the company names producing chains are: Roto mechanical  equipment Chennai: Monal Chains Limited, Mumbai; Innotech Engineers Ltd., New Delhi. |
| 4 | **Why tight-side of the belt should be at the bottom side of the pulley?** BTL4  The positions of input and output pulleys are such that the tight side of the belt must be on the  bottom and slack side on the top of the pulleys. Otherwise, the angle of contact between the belt and rim of the pulley reduces, decreasing the power transmission capacity of the belt. |
| 5 | **Define the term “Crowning of pulley”. (Nov/Dec-2016, May/June 2014)** BTL1  The pulley rims are tapered slightly towards the edges. This slight convexity is known as crowning. The crowning tends to keep the belt in centre on a pulley rim while in motion. These flat belts stayed centered on pulleys without any guides or flanges. The key to keeping them  tracking centered on the pulleys is the use of "crowned pulleys" |
| 6 | **A longer belt will last more than a shorter belt. Why? (Apr/May 2017)**BTL4  The life of a belt is a function of the centre distance between the driver and driven shafts and diameter of driver and driven pulleys. The shorter the belt, the more often it will be subjected to additional bending stresses while running around the pulleys at a given speed. And also it will  be destroyed quickly due to fatigue. Hence the increased centre distance and diameter of pulley  will increase the belt life. Hence, a longer belt will last more than a shorter belt. |
| 7 | **Mention the losses in belt drives. (Nov/Dec 2014)**BTL2 The losses in a belt drive are due to:   * Slip and creep of the belt on the pulleys (about 3%) * Bending of the belt over the pulleys (about 1%) * Friction in the bearings of pulley (about 1%) and * Windage or air resistance to the movement of belt and pulleys (usually negligible) |
| 8 | **In what ways the timing belts are superior to ordinary V-belts? (April/May 2015)**BTL4 Flat belt and V-belt drives cannot provide a precise speed ratio, because slippage occurs at the sheaves. But certain applications require an exact output to input speed ratio. In such situations, timing belts are used. Since the timing belts (aka. synchronous belts) possess toothed shape in their -inner side, engagement with toothed pulley will provide positive drive without, belt-slip where as in the case of ordinary V-belts, chances of slip are and hence positive drive is not  possible at all times. Hence toothed belts (I timing belts) are superior to ordinary V-belts. |
| 9 | **Why are idler pulleys used in a belt drive?**BTL4  Idler pulleys are used to take up slack, change the direction of transmission, or provide clutching action in any industry, material handling or any other mechanical purpose. But they don’t provide any mechanical advantage, nor does it transmit power. One such example of its application is to improve belt drive performances as they reduce vibration by supporting a segment of belt which is prone to vibration/oscillation. They are also used in car engines for positive clutching action by running the idler pulley on the slack side of the flat-belt drive from  engine to transmission. |
| 10 | **Name the few materials for belt drives. (May/June 2016)**BTL2   * Leather * Fabric and cotton * Rubber * Balata and * Nylon. |
| 11 | **State the law of belting.**BTL1  Law of belting states that the centre line of the belt as it approaches the pulley must lie in a plane perpendicular to the axis of that pulley or must lie in the plane of the pulley, otherwise the belt will run off the pulley. “The centreline of the belt when it approaches a pulley must lie in the midplane of the pulley”. |
| 12 | **What is wipping? How it can be avoided in belt drives?**BTL3  If the centre distances between two pulleys are too long then the belt begins to vibrate in a direction perpendicular to the direction of motion of belt. This phenomenon is called as  wipping. Wipping can be avoided by using idler pulleys. |
| 13 | **How are wire ropes designated? Give an example? (Nov/Dec 2012)**BTL2  Wire ropes are designated (or specified) by the number of strands and the number of wires in each strand. Standard Wire Rope, 6x7 Class Wire Rope, Strands: 6, Wires per Strand: 7, Core:  Fiber Core, Standard Grade(s): Improved Plow (IPS), Lay: Regular or Lang, Finish: Bright or |

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| 14 | **What do you understand by 6 x 19 constructions in wire ropes? (Nov/Dec 2014)**BTL2  A 6 x 19 wire rope means a rope is made from 6 strands with 19 wires in each strand. |
| 15 | **Give any three applications of chain drives. What are they limitations? (April/May 2011)**BTL2  Chain drives are widely used in transportation industry, agricultural machinery, metal and wood working machines.  Limitations: heavy height, sudden failure, intensive wear of the links in the joints  susceptibility to jerks and overloads. |
| 16 | **What is the effect of chordal action in chain drives? How can you reduce that effect? (April/May 2015)**BTL4  As the chain enters and exits, it rises and falls as each pitch engages and disengages the sprockets. This movement, called chordal action, causes chain speed variations (drive roughness) that may be objectionable in some applications. These speed variations can normally be minimized by increasing the size of the sprockets. Chordal action results in a pulsating and jerk motion of a chain. In order to reduce the variation in chain speed, the number of teeth on  the sprocket should be increased. |
| 17 | **What do you mean by galling of roller chains? (May/June 2012)**BTL3  Galling is a stick-slip phenomenon between the pin and the bushing. When the load is heavy and the speed is high, the high spots (i.e. joints) of the contacting surfaces are welded together. This phenomenon of welding is called as galling of roller chains. Use high quality, high pressure lubricants and ensure that the lubricant regime is such that the film of  lubricant is constantly maintained between the surfaces. |
| 18 | **Under what circumstances chain drives are preferred over V belt drives? (May/June 2016)**BTL4  The popularity of chain drives stems from their ability to transmit high torque levels in a small package, at relatively low cost, while utilizing readily available stock components. While initial costs of standard roller chain drives can be quite low, the cost of maintaining them can be substantial. The ability to create any length of chain with connecting links. The availability of a  large selection of chains and sprockets. |
| 19 | **What factors will affect the working conditions of chain drive? (Nov/Dec-2016)**BTL2   * Tension in the chains * Sizes of the pulley/gear * Number of pulley/gear * Length of the chain drive * Friction between chains & pulley/gear * Angle of contact. |
| 20 | **List the advantages of wire ropes compared to chains.(Apr/May-2017)**BTL1   * More reliable in operation * Silent operation even at high working speeds * Less danger for damage due to jerks. |

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| 21 | **What is centrifugal effect on belts? (Nov/Dec 2015)** BTL4  As the belt moves round the pulley, it would experience a centrifugal force which has a tendency to separate the belt from the pulley surface. To maintain contact between the pulley and belt, the centrifugal force produce additional tension in the belt, which is known as centrifugal tension  (TC=mv2). |
| 22 | **What are the factors upon which the coefficient of friction between the belt and pulley depends? (May/June 2014, 2012)**BTL2  The coefficient of friction between the belt material and pulley surface depends upon the belt  material, material of the pulley surfaces, belt speed and belt slip. |
| 23 | **Name the types of belts used for transmission of power.(May/June 2013)**BTL2   * Flat belts * V-belts * Ribbed belts * Toothed or timing belts |
| 24 | **List out the various stresses induced in the wire ropes. (May/June 2013)**BTL1   * Direct stress due to the weight of the load to be lifted. * Bending stress when the rope passes over the sheave * Stress due to acceleration * Stress due to starting and stopping * Effective stress. |
| 25 | **Mention the parts of roller chains.**(**Nov/Dec 2012)**BTL2   * Inner (pin link or coupling link) and outer link plates (roller link) * Pin * Bushing and rollers. |
|  | **PART \* B & C** |
| 1 | Design a flat belt drive to transmit 110 kW for a system consisting of two pulleys of diameters 0.9m and 1.2m for a centre distance of 3.6m, belt speed of 20 m/s and coefficient of friction is 0.3. There is a slip of 1.2% at each pulley and 5% friction loss at each shaft with 20% overload. **(13M)(Nov/Dec 2016)** BTL5  **Pulley diameters:** d = 0.9m, D = 1.2m |
| 2 | A V-belt drive is to transmit 15 kW to a compressor. The motor runs at 115 rpm and the compressor is to run at 400 rpm. Determine (i) Belt specification, (ii) Number of belts, (iii) Correct centre distance, (iv) Drive pulley diameters**. (13M)(Nov/Dec 2015)** BTL5 |
| 3 | At the construction site, 1 tonne of steel is to be lifted upto a height of 20 m with the help of 2 wire ropes of 6x19 size, nominal diameter 12 mm and breaking load 75 kN. Determine the factor of safety if the sheave diameter is 56d and wire rope is suddenly stopped in 1 second while travelling at a speed of 1.2 m/s. What is the factor of safety if bending load is neglected? **(13M)(Nov/Dec 2014)**BTL5 |
| 4 | A bucket elevator is to be driven by a geared motor and a roller chain drive with the information given below:  Motor output = 3 kW; speed of motor shaft = 100 rpm; elevator drive shaft speed = 42 rpm; load = even; distance between centres of sprockets approximately = 1.2m; period of operation = 16 hours/day; geared motor is mounted on an auxiliary bed for centre distance adjustments. Design the chain drive**. (13M)(Nov/Dec 2016)**BTL5 |
| 5 | A compressor is to run by a motor pulley running at 1440 rpm, speed ratio 2.5. Choose a  flat belt crossed drive. Centre distance between pulleys is 3.6 m. Take belt speed as 16 m/s. Load factor is 1.3. Take a 5-ply, flat Dunlop belt. Power to be transmitted is 12 kW. High speed load rating is 0.0118 kW/ply/mm width at v = 5 m/s. Determine the width and length of the belt. **(13M)(Nov/Dec 2014)**BTL5 |
| 6 | Design a V-belt drive and calculate the actual belt tensions and average stress for the following data:  Power to be transmitted = 7.5 kW; Speed of driving wheel = 1000 rpm; Speed of driven wheel = 300 rpm; Diameter of driven wheel = 500 mm; Diameter of driver pulley = 150 mm and centre distance = 925 mm**. (15M)(April/May 2015)**BTL5 |
| 7 | The transporter of a heat treatment furnace is driven by a 4.5 kW, 1440 rpm induction motor through a chain drive with a speed reduction ratio of 2.4. The transmission is horizontal with both type of lubrication. Rating is continuous with 3 shifts per day. Design the complete chain drive.**(15M)(Nov/Dec 2013)**BTL5 |
| 8 | A V-belt drive is to be arranged between two shafts with 1.2 m as centre distance. The driving pulley is of 250 mm effective diameter and is to be supplied with 20 kW power at 960 rpm. The follower pulley is to run at 460 rpm. Determine the number of belts required from the following:  Arc of the belt cross section = 143 mm2; Mass density of the belt material = 100 kg/m3; Permissible tensile stress = 2 N/mm2; Coefficient of friction = 0.3; Groove angle of the pulley, 2β = 40º. **(15M)(Nov/Dec 2015)**BTL5 |
| 9 | A 7.5 kW electric motor running at 1400 rpm is used to drive the input shaft of the gear box of a special purpose machine. Design a suitable roller chain to connect the motor shaft to the gear box shaft to give an exact speed ratio of 10 to 1. Assume the minimum centre distance between driver and driven shafts as 600 mm.**(15M)(May/June 2016)**BTL5 |

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| **UNIT II–SPUR GEARS AND PARALLEL AXIS HELICAL GEARS** | |
| Speed ratios and number of teeth-Force analysis -Tooth stresses - Dynamic effects – Fatigue strength- Factor of safety - Gear materials – Design of straight tooth spur & helical gears based on strengthand wear considerations – Pressure angle in the normal and transverse plane- Equivalent number ofteeth- forces for helical gears. | |
| **PART \* A** | |
| **Q.No.** | **Questions** |
| 1 | **Specify the conditions based on which gear cutters are selected.**BTL4   * The capacity of the machine size and shape of the gear * Proper material selection * The magnitude of production range * The production time * The technical experience of the machinist * The economic viability of the machine * The cutting forces |
| 2 | **Define backlash. What factors influence backlash in gear drives? (Nov/Dec 2016)**BTL1 Shortest distance between the non-contacting surfaces of the adjacent teeth is referred to as backlash.   * Module and * Pitch line velocity influence the backlash in gear drives. |
| 3 | **What are the advantages of the helical gear over spur gear?**BTL2   * Helical gears produce less noise than spur gears of equivalent quality because the total contact ratio is increased. * Helical gears have a greater load carrying capacity than equivalent size of spur gears. * A limited number of standard cutters are used to cut a wide variety of helical gears simply by varying the helix angle. * Smoother engagement of the gear teeth. * More teeth carry load at a given time so that they are more efficient – carry more load for a given size. |
| 4 | **What are the main types of gear tooth failure? (May/June2013, 2012)**BTL1   * Tooth breakage (due to static and dynamic loads). * Tooth wear (or surface deterioration): (a) Abrasion; (b) Pitting and(c) Scoring or seizure. |
| 5 | **What are the assumptions made in deriving Lewis equation?**BTL3   * The effect of radial component, which induces compressive stresses, is negligible. * The tangential component is uniformly distributed across the full face width. * The tangential force is applied to the tip of a single tooth. * Stress concentration in the tooth fillet is negligible. |
| 6 | **Why is pinion made harder than gear? (Nov/Dec 2012)**BTL4  Since the teeth of pinion undergo more number of cycles than gear and hence quicker wear. |

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| 7 | **List out the various methods of manufacturing a gear.**BTL2   * Gear milling, * Gear generating, * Gear hobbing, * Gear shaping, * Gear molding, * Injection molding, * Die casting and * Investment casting. |
| 8 | **What are the common forms of gear tooth profile? (Apr/May 2011)**BTL1   * Involute tooth profile and * Cycloidal tooth profile. |
| 9 | **What are the standard interchangeable tooth profiles?**BTL2   * 14½0 composite system * 14½0 full depth involute system * 200 full depth involute system and * 200 stub involute system. |
| 10 | **What are the effects of increasing and decreasing the pressure angle in gear design? (April/May 2015, 2017&2014, Nov/Dec 2014)**BTL4   * Increasing the pressure angle will increase the beam and surface strengths of tooth. But gear becomes noisy. * Decreasing the pressure angle will increase the minimum number of teeth required on   the pinion to avoid interference/ undercutting. |
| 11 | **A helical gear has a normal pressure angle of 20 degrees, a helix angle of 45 degrees, normal module of 4mm and has 20 teeth. Find the pitch diameter. (Nov/Dec 2016)**BTL5  Solution : Pitch circle diameter (d) = (mn x Z)/ cosβ, = (4x20)/cos45 = 113.3 = 114mm |
| 12 | **Differentiate double helical and herringbone gears. (Nov/Dec 2015, Apr/May 2017)** BTL4 When there is groove in between the gears, then the gears are specifically known as double helical gears. When there is no groove in between the gears, then the gears is known as  herringbone gears. |
| 13 | **Write short notes on stub tooth system. (May/June2012)**BTL1  In this system, the thickness of tooth at top surface and its root is more compare to full depth tooth system. Also this kind of tooth possesses shorter addendum and larger pressure angle, usually 200 and thus interference problem may be eliminated. For standard stub tooth system, the tooth proportion are as Whole depth=1.8\*module; Addendum==0.8\*module;  Dedendum=1.0\*module; Working Depth=1.6\*module; Clearance=0.2\*module; |
| 14 | **What are the advantages of helical gears? [(Nov/Dec 2012)**BTL2   * Transmit more power * Provide smooth and * Soundless operation. |

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| 15 | **What are the profiles of a spur gear? (May/June 2016)**BTL1  Two constant velocity tooth profiles are the most commonly used in modern times: the cycloid and the involute. |
| 16 | **What is herringbone gear? (May/June 2016)**BTL1  Herringbone gears, also called double helical gears, are gear sets designed to transmit power through parallel or, less commonly, perpendicular axes. The unique tooth structure of a herringbone gear consists of two adjoining, opposite helixes that appear in the shape of the letter 'V'.Double helical gears are used in many applications such as cranes, fluid pumps and power transmission to the propulsion screws in military ships for a quieter and less vibration  operation. |
| 17 | **State the advantages of Herringbone gear. (April/May 2015, 2013)**BTL1  Herringbone gears eliminate the existence of axial thrust load in the helical gears. Because, in herringbone gears, the thrust force of the right hand is balanced by that of the left hand helix. |
| 18 | **Why is a gear tooth subjected to dynamic load? (Nov/Dec 2014)**BTL4 Dynamic loads are due to   * In accuracies of tooth spacing * Irregularities in tooth profiles * Elasticity of parts * Misalignment between bearings * Deflection of teeth under load * Dynamic unbalance of rotating masses. |
| 19 | **Compare the features of spur and helical gears. (Nov/Dec 2012)**BTL4 **Advantages of the spur gear**:   * Spur gears are simplest, hence easiest to design and manufacture. * A spur gear is more efficient if you compare it with helical gear of same size. * Easy to assemble   **Advantages of the helical gear**:   * Silent operation * Helical gears can be used for transferring power between non-parallel shafts. * For same tooth size (module) and equivalent width, helical gears can handle more load than spur gears because the helical gear tooth is effectively larger since it is diagonally positioned. |
| 20 | **Define the various pitch in a helical gear. (May/June 2012)**BTL1   * Transverse circular pitch (Pt) * Normal circular pitch (Pn) * Axial Pitch (Pa) * Normal diametral pitch (Pd) |
| 21 | **State the law of gearing. (or) State the conditions of correct gearing. (Nov/Dec2012, April**  **/May 2015)(or) What conditions must be satisfied in order that a pair of spur gears may have constant velocity ratio?**(**May/June 2014)**BTL1  The law of gearing states that for obtaining a constant velocity ratio, at any instant of teeth the common normal at each point of contact should always pass through a pitch point (fixed point), situated on the line joining the centres of rotation of the pair of mating gears.  The angular velocity ratio of the gears of a gear-set must remain constant throughout the mesh. |

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| 22 | **State some materials used for manufacturing of gears. (May/June 2013)**BTL1  Metallic gears: steel, cast iron and bronze. Non-metallic gears: wood, compressed paper and synthetic resins. |
| 23 | **Define module. (April/May 2011, May/June 2013, Nov/Dec 2015)**BTL1  Module, m this indicates the tooth size and is the number of mm of pitch circle diameter (p.c.d.) per tooth. For gears to mesh, their modules must be equal. Gear ISO standards and design methods are now normally based on the module. EG a gear of module 3 has 16 teeth, its pitch  circle diameter is: 3 x 16 = 48 mm. In a pair of spur gears, the module is 6 mm. |
| 24 | **What are the advantages of toothed gears over the other types of transmission systems?**BTL2  Advantages of gear drives over other drives, i.e. belt, rope and chain drives are   * It is very compact and need less space. * It has a very high efficiency which is very useful in transmitting motion. * The main advantage of gear drive is that it transmit same velocity ratio. * Again a good advantage is that it is a very good reliable service. * And last is that it can be used to transmit a very large power. |
| 25 | **What is pressure angle? (April /May 2015 & 2014, Nov/Dec 2014)**BTL1  It is the angle which the line of action makes with the common tangent to pitch circles of mating gears. Simply refers to the angle through which forces are transmitted between meshing gears. Ideally 20° of pressure angle (involute system) is preferred because the tooth  acting as a beam is wider at the base. |
|  | **PART \* B & C** |
| 1 | A speed reducing unit using spur gear is to be designed. Power to be transmitted is 60 hp and is continuous with moderate shock loads. The speeds of the shafts are 720 rpm and 144 rpm respectively. The centre distance is kept as small as possible. Select a suitable material and design the gears. Give the details of the gears**.(13M)(May/June 2016)**BTL5 |
| 2 | In a spur gear drive for a stone crusher, the gears are made of C40 steel. The pinion is transmitting 30 kW at 1200 rpm. The gear ratio is 3. Gear is to work 8 hours per day, six days a week and for 3 years. Design the drive**.(13M)(Nov/Dec 2016)**BTL5 |
| 3 | Design a pair of straight gear drive for a stone crusher, the pinion and wheel are made of C15 steel and cast iron grade 30 respectively. The pinion is to transmit 22 kW power at 900 rpm. The gear ratio is 2.5. Take pressure angle of 20º and working life of gear as 10000 hours.**(13M)(Nov/Dec 2016)**BTL5 |
| 4 | A pair of helical gears subjected to moderate shock loading is to transmit 30 kW at 1500 rpm of the pinion. The speed reduction ratio is 4 and the helix angle is 20º. The service is continuous and the teeth are 20º FD in the normal plane. For gear life of 10,000 hours, design the gear drive.**(13M)**(**May/June 2016)**BTL5 |
| 5 | Design a helical gear drive to transmit a power of 15 kW at 1440 rpm to the following specifications: Speed reduction is 3, pressure angle is 20º, helix angle is 15º, material of both gears is C45 steel, allowable static stress is 180 N/mm2, Young’s modulus = 2 X 105 N/mm2.**(13M)(Nov/Dec 2010)**BTL5 |
| 6 | Design a straight spur gear drive to transmit 8 kW. The pinion speed is 720 rpm and the speed ratio is 2. Both the gears are made of the same surface hardened carbon steel with 55 RC and core hardness less than 350 BHN. Ultimate strength is 720 N/mm2 and yield strength is360 N/mm2**.(15M)(Nov/Dec 2015)**BTL5 |
| 7 | Design a spur gear drive required to transmit 45 kW at a pinion speed of 800 rpm. The velocity ratio is 3.5:1. The teeth are 20 º full depths involute with 18 teeth on the pinion. Both the pinion and gear are made of steel with a maximum safe static stress of 180 N/mm2. Assume medium shock conditions.**(15M)(Nov/Dec 2015)**BTL5 |
| 8 | Design a pair of helical gears to transmit 10 kW at 1000 rpm of the pinion. Reduction ratio of 5 is required. Pressure angle is 20º and the helix angle is 15º. The material for both the gears is 40Ni2 Cr1 Mo28. Give the details of the drive in a tabular form**.(15M)(Nov/Dec 2016)**BTL5 |

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| **UNIT III–BEVEL, WORM AND CROSS HELICAL GEARS** | |
| Straight bevel gear: Tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of pair of straight bevel gears. Worm Gear: Merits and demeritsterminology.Thermal capacity, materials-forces and stresses, efficiency, estimating the size of the worm gear pair. Cross helical: Terminology-helix angles-Estimating the size of the pair of cross helical gears. | |
| **PART \* A** | |
| **Q.No.** | **Questions** |
| 1 | **What is virtual or formative number of teeth in bevel gears? (Nov/Dec 2014, April/May 2017, May/June 2014)**BTL1  An imaginary spur gear considered in a plane perpendicular to the tooth of the bevel gear at the larger end is known as virtual spur gear. The number of teeth zv on this imaginary spur gear  is called virtual number of teeth in bevel gears. zv = z/cos δ where z = actual number of teeth on the bevel gear and δ = pitch angle. |
| 2 | **Define the following terms: (a) Cone distance (b) Face angle. (May/June 2014)**BTL1 (a) Cone distance: In bevel gears, cone distance is the length of the pitch cone element. (b) Face  Angle: It is the angle subtended by the face of the tooth at the cone centre. |
| 3 | **Why is the efficiency of worm gear drive comparatively low?**BTL4  The efficiency of worm gear drive is lower because of power loss due to friction caused by sliding. |
| 4 | **In which gear drive, self-locking is available? (April/May 2015, 2013)**BTL3  In the worm gear drive, self-locking is available. |
| 5 | **Write the conditions of self-locking of worm gears in terms of lead and pressure angle in gear design. And also write the condition for over running drives. (Apr/May 2017)**BTL3   * The drive is called self-locking, if µ ≥ cos α. tan γ * The drive is called overrunning, if µ < cos γ. tan γ |
| 6 | **Why is multistart worm more efficient than the single start one?**BTL4  The efficiency of the worm depends mainly on pressure angle (also known as pitch angle of the worm). For a single start worm this pressure angle will be less. In a multi start worm, this pressure angle can be increased (of the order 450). That’s why multi start worm is more  efficient. |
| 7 | **What is the difference between an angular gear and a miter gear? (Nov/Dec 2015)**BTL4   * When the bevel gears connect two shafts whose axes intersect at an angle other than a right angle, then they are known as angular bevel gears. * When equal bevel gears (having equal teeth and equal pitch angles) connect two shafts   Whose axes intersect at right angle, then they are known as miter gears. |
| 8 | **A pair of worm gears is designated as 2/54/10/5. Find the gear ratio.** BTL5  Solution: (2/54/10/5): (z1/z2/q/mx)Therefore, Gear ratio, i = z2/z1 = 54/2 = 27 |
| 9 | **Why phosphor bronze is widely used for worm gears?** BTL4  Phosphor bronze has high antifriction properties to resist seizure. Because in worm gear drive, the failure due to seizure is more. |

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| 10 | **List out the main types of failure in worm gear drive. (Nov/Dec 2012)**BTL2   * Seizure * Pitting and rupture. |
| 11 | **For transmitting large power, worm reduction gears are not generally preferred. Why?**BTL4  In worm drive, meshing occurs with sliding action. Since sliding occurs, the amount of  heat generation and power loss are quite high. |
| 12 | **In worm gear drive, only the wheel is designed. Why? (Apr/May 2011)**BTL4  Since always the strength of the worm is greater than the worm wheel, therefore only the worm wheel is designed. |
| 13 | **What are the forces acting on bevel gear? (May/June 2013)**BTL2   * Tangential force * Separating force: It is resolved into two components, they are axial radial force. |
| 14 | **Under what situation, bevel gears are used? (Apr/May 2011)**BTL3  Bevel gears are used to transmit power between two intersecting shafts. |
| 15 | **Write some applications of worm gear drive. (Nov-Dec 2016)**BTL2 **Where do we use worm gears? (May/June2013)**  It is commonly used in automotive differentials**,** Tuning Instruments , Elevators/Lifts, Gates and  Conveyor Belts |
| 16 | **What are the main types of failures in worm gear drives?(Nov/Dec2012)**BTL2   * Seizure * Pitting * Surface wear |
| 17 | **What is the helical angle of worm? (May/June 2016)**BTL1  In mechanical engineering, a helix angle is the angle between any helix and an axial line on its right, circular cylinder or cone. Common applications are screws, helical gears, and worm gears. The helix angle references the axis of the cylinder, distinguishing it from the lead angle, which references a line perpendicular to the axis. Naturally, the helix angle is the geometric  complement of the lead angle. The helix angle is measured in degrees. |
| 18 | **What is a crown gear? (Nov/Dec 2016, May/June 2013)**BTL1  A crown gear (or a contrate gear) is a gear which has teeth that project at right angles to the face of the wheel. In particular, a crown gear is a type of bevel gear where the pitch cone angle is 90 degrees. |
| 19 | **How bevel gears are manufactured**? (**May/June 2016)**BTL1  Bevel gears can be manufactured through the gear hobbing and machining process. |
| 20 | Sliding contact is required between worm and worm wheel. For other gears Line contact is  required for other gears. |
| 21 | **What is a Zero Bevel Gears? (April/May 2015)**BTL1  Spiral bevel gears with curved teeth but with a zero degree spiral angle are known as zero bevel gears. |

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| 22 | **Mention the advantages of worm gear drive. (Nov/Dec 2014)**BTL2  Worm gears are used to transmit power between two non-intersecting, non-parallel shafts. Worm gears can be used for high speed reduction ratios as high as 300:1. |
| 23 | **When do we employ crossed helical gear? (Nov/Dec 2012)**BTL4  Crossed helical gear sets are used to transmit power and motion between non-intersecting and non-parallel axes. Both of the gears that mesh with each other are involute helical gears, and a point contact is made between them. They can stand a small change in the center distance and  the shaft angle without any impairment in the accuracy of transmitting motion. |
| 24 | **List the various types of Bevel gears. (May/June 2012)**BTL2   * Straight bevel gears * Spiral bevel gears * Zero bevel gears * Hypoid gears |
| 25 | **What are the various losses in the worm gear drive? (May/June 2012)**BTL2  Worm drives have high power losses. A disadvantage is the potential for considerable sliding action, leading to low efficiency. They produce a lot of heat. High-ratio units have a smaller gear- tooth lead (helix) angle, which causes more surface contact between them. This higher contact causes higher friction and lower efficiency. Typical worm-gear efficiencies range from 49% for a 300:1, double-reduction ratio, up to 90% for a 5:1, single-reduction ratio. For this reason, these  units are usually more suitable for low ratios. |
|  | **PART \* B & C** |
| 1 | Design a bevel gear drive to transmit 3.5 kW with driving shaft speed is 200 rpm. Speed ratio required is 4. The drive is non-reversible. Pinion is made of steel and wheel made of CI. Assume a life of 25,000 hrs. **(13M)(Nov/Dec 2016)**BTL5 |
| 2 | A pair of cast iron bevel gears connects 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 14½º composite form. The allowable static stress for both gears is 55 MPa. If the pinion transmits 2.75 kW at 1100 rpm, find the module and number of teeth on each gear and check the design. Take surface endurance limits as 630 MPa and modulus of elasticity for cast iron as 84 kN/mm2**.(13M)(Nov/Dec 2009)**BTL5 |
| 3 | Design a pair of straight bevel gears for two shafts whose axes are at right angle. The power transmitted is 25 kW. The speed of pinion is 300 rpm and the gear is 120 rpm. Assume 15 Ni2 Cr1 Mo15 steel for both the pinion and wheel. Use Hertz stresses method.**(13M)**BTL5 |
| 4 | 2 kW power is applied to a worm shaft at 720 rpm. The worm is of quadruple start with 50 mm as pitch circle diameter. The worm gear has 40 teeth with 5 mm module. The pressure angle in the diametral plane is 20º. Determine: (i) the lead angle of the worm, (ii) velocity ratio and, (iii) centre distance. Also calculate efficiency of the worm gear drive and power lost in friction.**(13M)(May/June 2014)**BTL5 |
| 5 | Design a worm gear drive to transmit 20 kW at 1440 rpm, speed of worm wheel is 60 rpm.**(13M)(May/June 2016)**BTL |
| 6 | Design a pair of right angle bevel gears to transmit 15 kW at 75 rpm to another gear to run at 250 rpm. Not less than 20 teeth are to be used on either gear. The pressure angle is 20º. Assume a gear life of 12000 hrs.**(15M)(Nov/Dec 2015)**BTL5 |
| 7 | A hardened steel worm rotates at 1440 rpm and transmits 12 kW to a phosphor bronze gear. The speed of the worm gear should be 60 rpm. Design the worm gear drive if an efficiency of atleast 82% is desired.**(15M)(Nov/Dec 2016)**BTL5 |
| 8 | The input to worm gear shaft is 18 kW at 600 rpm, speed ratio is 20. The worm is to be of hardened steel and the wheel is made of chilled phosphor bronze. Considering wear and strength, design worm and worm wheel.**(15M)(Nov/Dec 2015)**BTL5 |

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| **UNIT IV–GEAR BOXES** | |
| Geometric progression - Standard step ratio - Ray diagram, kinematics layout -Design of sliding mesh gear box - Design of multi speed gear box for machine tool applications - Constant mesh gear box -Speed  reducer unit–Variable speed gear box, Fluid Couplings, Torque Converters for automotive applications. | |
| **PART \* A** | |
| **Q.No.** | **Questions** |
| 1 | **Calculate standard step ratio for six speed gear box with speed ranging between 100 and 560rpm.**BTL5  ɸ = [NMax/NMin]1/n-1  = [560/100]1/6-1  =1.411 |
| 2 | **Comment on the number of gears to be used in the output shaft. (May/June 2012)**BTL3  It is practiced in the gear box that output shaft is fixed with maximum of three gears. |
| 3 | **What are the methods of lubrication in speed reducers?**BTL2   * Splash or spray lubricating method and * Pressure lubrication method. |
| 4 | **List any two methods used for changing speeds in gear boxes. (Nov/Dec 2016)**BTL2   * Sliding mesh gear box and * Constant mesh gear box |
| 5 | **Write any two requirements of a speed gear box.**BTL2   * Gear box should provide the designed series of spindle speeds. * Gear box should transmit the required amount of power to the spindle. |
| 6 | **Differentiate ray diagram and structural diagram. (or) What does the ray diagram of gear box indicates? (May/June 2012, Nov/Dec 2016)**BTL4  The ray diagram is a graphical representation of the drive arrangement in general form. It serves the specific values of all the transmission ratios and speed of all the shafts in the drive.  The structural diagrams are drawn from the structural formulae which is a graphical tool used to  find the range ratio of transmission groups. The structural diagram gives information about the number of shafts and the number of gears on each shaft. |

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| 7 | **Write the structural formula for a six speed gear box.**BTL3  A typical ray diagram for a six speed gear box, for the preferred structural formula 3(1) 2(3), is shown below. |
| 8 | **Select 3 pairs of gears with total teeth for each pair 60 and speed ratios 1, 1.41, and 2.**BTL4 z1+ z2=z3+ z4= z5+ z6=60;  i= z2/ z1=1; i=z4/ z3=1.41; i= z6/ z5=2  z1=30; z2=30; z3=25: z4=36: z5=20: z6=40 |
| 9 | **State any three basic rules to be followed while designing a gear box.**BTL1   * The transmission ratio in a gear box is limited by ¼ ≤ i ≤ 2. * For stable operation, the speed ratio of any stage should not be greater than 8. i.e., N max/ Nmin ≤ 8. * In all stages except in the first stage, N max ≥ Ninput> Nmin |
| 10 | **What is the function of spacers in a gear-box?**BTL1  The function of spacers is to provide the necessary distance between the gears and the bearings. |
| 11 | **List out the possible arrangements to achieve 16 speed gear box.**BTL2   * 4 x 2 x 2 scheme * 2 x 4 x 2 scheme and * 2 x 2 x 4 schemes |
| 12 | **What are the possible arrangements to achieve 12 speeds from a gear box? (April/May 2011, May/June 2013)**BTL3  The possible arrangements are:   * 3 x 2 x 2 scheme * 2 x 3 x 2 scheme and * 2 x 2 x 3 scheme. |
| 13 | **Sketch the kinematics layout of gears for 3 speeds between two shafts.**BTL3  download |
| 14 | **What are preferred numbers? (Apr/May 2011,2013, Nov/Dec 2014)**BTL2  **Name the series in which speeds of multi speed gear box are arranged. [May/June 2014]**  Preferred numbers are the conventionally rounded off values derived from geometric series. There are five basic series, denoted as R 5, R 10, R 20, R 40 and R 80 series. |
| 15 | **What does the ray-diagram of gear box indicates? (May/June 2012, Apr/May 2017)**BTL3 The ray diagram is a graphical representation of the drive arrangement in general form. It  serves to determine the specific values of all the transmission ratios and speeds of all the shafts in the drive. |

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| 16 | **What is step ratio? (or) Define progression ratio. (Nov/Dec 2015, May/June 2014)**BTL1  When the spindle speeds are arranged in geometric progression, then the ratio between the two adjacent speeds is known as step ratio or progression ratio. |
| 17 | **Draw the ray diagram for 12 speed gear box. (May/June 2013)**BTL3  Description: Image result for ray diagram for 12 speed gear box? |
| 18 | **What is a speed reducer?**BTL1  Speed reducer is a gear mechanism with a constant speed ratio, to reduce the angular speed of output shaft as compared with that of input shaft. |
| 19 | **Specify four types of gear box.(Nov/Dec 2014)**BTL2   * Sliding mesh gear box, * constant mesh gear box, * synchromesh gearbox, * Planetary gearbox. |
| 20 | **What is multispeed gear box? (May/June 2016)**BTL1  A gearbox that converts a high speed input into a number of different speed output it is called a multi-speed gear box. Multi speed gear box has more than two gears and shafts. A multi speed gearbox reduces the speed in different stages. |
| 21 | **Why geometric progression is selected for arranging the speeds in gear box? (Apr/May 2017)**BTL2  When the speeds are arranged in G.P, it has the following advantages over the other progressions.   * The speed loss is minimum * No.of gears to be employed is minimum * G.P provides a more even range of spindle speeds at each step. * The lay out is comparatively very compact. * G.P m/c tool spindle speeds can be selected easily from preferred numbers, because preferred numbers are in geometric progression. |
| 22 | **What is R20 series? (May/June 2016)**BTL1  In [industrial design,](https://en.wikipedia.org/wiki/Industrial_design) preferred numbers (also called preferred values, preferred series or convenient numbers are standard guidelines for choosing exact product dimensions within a given set of constraints. Product developers must choose numerous lengths, distances, diameters, volumes, and other characteristic [quantities](https://en.wikipedia.org/wiki/Quantities).  Preferred numbers represent preferences of simple numbers (such as 1, 2, and 5) and their powers of a convenient basis, usually 10. The R5, R10 and R20 series refers to the Renard 5 (first-choice sizes 60 % increments), Renard 10 (second-choice sizes 25 % increments) and Renard 20 (third-choice sizes 12 % increments) series of preferred numbers standardized in  ISO3. |
| |  |  | | --- | --- | | 23 | **Write the significance of structural formula. (Nov/Dec 2015)**BTL1  Structural formula is used to find the number of speeds (n) available at the spindle and through no. Stages it can be achieved.  n = p1 (X1) .p2 (X2).p2 (X3)  p= stages in the gear box,  X = Characteristic of the stage. | | 24 | **List four application where constant mesh gear box is used. (Nov/Dec 2012)**BTL2 Vehicles which use this type of gearboxes are farm trucks, motorcycles, and heavy machinery. The availability of such mechanisms like constant mesh gearbox which create  less noise and are cost effective. | | 25 | **What are the conditions required for interchangeability of toothed Gears? (Nov/Dec 2012)**BTL3  For interchangeability of all gears, the set must have the same circular pitch, module,  diameter pitch, pressure, angle, addendum and dedendum and tooth thickness must be one half of the circular pitch. | |  | **PART \* B & C** | | 1 | Sketch three possible ray diagrams for a 6 speed gearbox with 2x3 arrangements. Choose the best possible ray diagram. Give suitable explanation for the same**. (13M)(April/May 2010)**BTL5 | | 2 | A sliding mesh gearbox is to be used for 4 forward and 1 reverse speeds. First gear speed ratio is 5.5 and reverse gear ratio is 5.8. Clutch gear on clutch shaft and gear (in constant mesh) on lay shaft has speed ratio of 2. Calculate the number of teeth on all the gears. Assume that the minimum number of teeth on any gear should not be less than 18. Calculate actual gear ratios. Assume that the geometric progression for gear ratios, top gear (fourth), third gear, second and first gear is 1:x:x2:x**3. (13M)(Nov/Dec 2014)**BTL5 | | 3 | Design a four speed gearbox to have following speed ratio. First gear is 5:1, second gear is 3:1, third gear is 1.5:1 and the top gear is 1:1. The centre distance between the input and output shafts is 150 mm. All gears are of 4 mm module, Determine the number of teeth of all wheels, pitch circle diameter of all wheels and sketch the diagrammatic arrangement of the gear box. (Assume number of teeth not less than 20 and pressure angle 20º.**(13M)(Nov/Dec 2015)**BTL5 | | 4 | A gear box is to give 18 speeds for a spindle of a milling machine. Maximum and minimum speeds of the spindle are to be around 650 and 35 rpm respectively. Find the speed ratios which will give the desired speeds and draw the structural diagram and kinematic arrangement of the drive**.(13M)(Nov/Dec 2015)**BTL5 | | 5 | A nine speed gear box, used as a head stock gearbox for a turret lathe, is to provide a speed range of 180 rpm to 1800 rpm. Using standard step ratio, draw the speed diagram and kinematic layout.**(13M)(May/June 2011)**BTL5 | | 6 | Draw the kinematic diagram and speed diagram of the head stock gearbox of a turret lathe arrangement for 9 spindle speeds, ranging from 31.5 rpm to 1050 rpm. Calculate the number of teeth on each gear. Minimum number of teeth on a gear is 25. Also calculate the percentage deviation of the obtainable speeds.**(15M)(May/June 2016)**BTL5 | | 7 | Sketch the arrangements of a six speed gearbox. The minimum and maximum speeds required are around 460 and 1400 rpm. Drive speed is 1440 rpm. Construct speed diagram of the gearbox and obtain various reduction ratios. Use standard output speeds and standard step ratio. Calculate number of teeth in each gear and verify whether the actual output speeds are within ±2% of standard spee**ds.(15M)(May/June 2014)**BTL5 | | 8 | A six speed gearbox is required to provide output speeds in the range of 125 to 400 rpm, with a step ratio of 1.25 and transmit a power 5 kW at 710 rpm. Draw the speed diagram and kinematic diagram. Determine the number of teeth, module and face width of all gears, assuming materials for gears. Determine the length of the gearbox along the axis of the gear shaft.**(15M)(May/June 2016)**BTL5 |   **UNIT V – CAM, CLUTCHES AND BRAKES** | |
| Cam Design: Types-pressure angle and under cutting base circle determination-forces and surfacestresses. Design of plate clutches –axial clutches-cone clutches-internal expanding rim clutches-  Electromagnetic clutches. Band and Block brakes - external shoe brakes - Internal expanding shoebrake. | |
| **PART \* A** | |
| **Q.No.** | **Questions** |
| 1 | **What are the desirable properties of friction material to be used for clutches?**BTL2   * A high and uniform coefficient of friction. * Good resiliency * The ability to withstand high temperatures, together with good heat conductivity. * High resistance to wear, scoring and galling. * Friction materials are basically composite materials made up of strands and fiber composites. |
| 2 | **Classify clutches based on the coupling methods. (May/June 2014)**BTL2   * Positive contact clutches * Frictional clutches * Overrunning clutches * Magnetic clutches and * Fluid couplings. |
| 3 | **What is fade? (May/June 2012, May/June 2013)**BTL1  When the brake is applied continuously over a period of time, the brake becomes overheated and the coefficient of friction drops. This results in sudden fall of efficiency of the brake. This  phenomenon is known as ‘fade’ of ‘fading’. |
| 4 | **Distinguish between coupling and a clutch. (Nov/Dec 2012)**BTL4  Couplings are used as permanent connecting elements between two power transmitting elements whereas clutches are used as temporary connecting elements. Thus periodical  engagement is possible in clutch connection. |
| 5 | **Why in automobiles, braking action when travelling in reverse is not as effective as when moving forward? (April/May 2015)**BTL2  When an automobile moves forward, the braking force acts in the opposite direction to the direction of motion of the vehicle Whereas in reverse travelling the braking force acts in the same direction to the direction of motion of the vehicle. So it requires more braking force to  apply brake. |
| 6 | **What is the axial force required at the engagement and disengagement of cone clutch? (May/June2013)**BTL2   * For engagement: We = Wn (1 + µ cot α), * For disengagement: Wd= Wn (1 - µ cot α). |
| 7 | **What is the function of a clutch in a transmission systems? (May/June 2016)**BTL1  The clutch is a mechanical device which is used to connect or disconnect the source of power at the operator’s will. |
| 8 | **What is a self-locking brake? (Apr/May 2011**, **May/June 2013, Nov/Dec 2012)**BTL1  When the frictional force is sufficient enough to apply the brake with no external force, then the brake is said to be self-locking brake. |
| 9 | **What you meant by self-energizing brake? (Nov/Dec 2016, May/June 2014, 2013)**BTL1 When the moment of applied force (F. l) and the moment of the frictional force (µ . RN . c) are in the same direction, then frictional force helps in applying the brake. This type of brake is  known as a self-energizing brake. |
| 10 | **How can pressure angle be reduced in cam design? (May/June 2012)**BTL2  It can be reduced by increasing the cam size or by adjusting the offset. Higher the pressure  angle higher the side thrust and higher the chances of jamming the translating follower in its guide ways. |
| 11 | **If a multidisc clutch has 8 discs in driving shaft and 9 discs in driven shaft, then how many number of contact surfaces it will have? (April/May 2015)**BTL5  Given data : n1 = 8; n2 = 9  Solution : Number of pair of contact surface, n = n1 + n2 -1 = 8+9-1 = 16 |
| 12 | **Name different types of clutch.** BTL2   * Single Plate clutch * Multi plate Clutch * Cone Clutch * Centrifugal Clutch |
| 13 | **How does the function of a brake differ from that of a clutch?** BTL4  Clutch used to engage and disengage the engine from the transmission system when applied. Brake is used to stop the vehicle when applied due to frictional power. |
| 14 | **What is the significance of pressure angle in CAM design? (May/June 2016)**BTL3  It is the measure of steepness of the cam profile. The angle between the direction of the follower movement and the normal to the pitch curve at any point is called pressure angle. Pressure angle varies from maximum to minimum during complete rotation. |
| 15 | **Mention a few applications of Cams.(Nov/Dec 2016)**BTL2  Cam mechanisms are used in various areas of machine building, such as internal-combustion engines, metal-cutting machines, and machines of the food industry, in which the cam mechanism performs a programmed operation, as well as in automated machines, in which cam mechanisms perform control functions, connecting and disconnecting working parts at the  proper moment. |
| 16 | **Differentiate between uniform pressure and uniform wear theories adopted in the design of clutches.(Nov/Dec 2014)**BTL4   * For uniform pressure theory Mean radius of friction surface (R) = 2/3[r13 – r23/r12-r22] * For uniform wear theory Mean radius of friction surface (R) = [r1 +r2] /2 |

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| 17 | **Double shoe brakes are preferred than single shoe brakes. Why? (April /May 2017)**BTL4 If only one block is used for braking, then there will be side thrust on the bearing of wheel shaft. This drawback can be removed by providing two blocks on the two sides of the drum.  The double shoes on the drum reduce the unbalanced force on the shaft. |
| 18 | **What are the effects of temperature rise in clutches? (May/June 2013)**BTL2 Because the temperature rise beyond the permissible range in brakes will cause:   * Excessive wear * Distortion of the brake linings and * Surface cracks due to thermal stresses. |
| 19 | **Differentiate a brake and a dynamometer.(April /May 2017)**BTL4   * Brake is a mechanical device by means of a body is retarded for slowing down or to bring it to rest, by applying artificial frictional resistance. * A dynamometer is a brake incorporating a device to measure the frictional resistance   applied. This is used for measuring the driving forces or torque transmitted and hence the power developed by the machine. |
| 20 | **Name four materials used for lining of friction surfaces in clutches. (or) Name few commonly used friction materials.** BTL2   * Wood * Cork * Leather * Asbestos based friction materials and * Powdered metal friction materials. |
| 21 | **In a hoisting machinery, what are the different energies absorbed by a brake system? (Nov/Dec 2014)**BTL2  In hoists and elevators, the potential energy released by the objects during the braking period is  absorbed by the brake. |
| 22 | **In cone clutches semi-cone angle should be greater than 12 deg. Why? (May/June 2012)**BTL4  The semi cone angle is kept greater than a certain value to avoid self-engagement; otherwise disengagement of clutch would be difficult. This is kept around 12.5deg.if the angle is less than  this value than the clutch is liable to jam in engagement |
| 23 | **Sketch the internal shoe brake and name the various parts**.**(May/June 2012)**BTL3  Description: Image result for internal shoe brake and name the various parts |

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| 24 | **Name the profile of cam that gives no jerk. (Nov/Dec 2015)**BTL2  Cycloidal curve profile of cam that gives no jerk. |
| 25 | **What is meant by positive clutch? (Nov/Dec 2015)**BTL1  Positive-contact clutches have interlocking engaging surfaces to form a rigid mechanical junction. |
|  | **PART \* B** |
| 1 | A single shoe brake is shown. The diameter of drum is 250 mm and angle of contact is 90º. If the operating force of 750 N is applied at the end of the lever and µ = 0.35, determine the torque that may be transmitted by the brake.**(13M)(Nov/Dec 2016)**BTL5 |
| 2 | A power of 20 kW is to be transmitted through a cone clutch at 500 rpm. For uniform wear condition, find the main dimensions of clutch and shaft. Also determine the axial force required to engage the clutch. Assume coefficient of friction as 0.25, the maximum normal pressure on the friction surface is not be exceeds 0.08 MPa and take the design stress for the shaft materials as 40 MPa.**(13M)(April/May 2015)**BTL5 |
| 3 | A 50 kg wheel, 0.5 m in diameter turning at 150 rpm in stationary bearings is brought to rest by pressing a brake shoe radially against the rim with a force of 100 N. If the radius of gyration of wheel is 0.2 m, how many revolution will the wheel make before coming to rest? Assume that the coefficient of friction between shoe and rim has the steady value 0.25.(**13M)(May/June 2016)]**BTL5 |
| 4 | A radial cam rotates at 1200 rpm with translating flat face follower rising 20 mm with simple harmonic motion in 150º of cam rotation. The base circle radius is 38 mm. Check whether undercutting will occur. **(13M)(Nov/Dec 2016)**BTL5 |
| 5 | An automobile single plate clutch consists of two pairs of contacting surfaces. The inner and outer radii of friction are 120 mm and 250 mm respectively. The coefficient of friction is  0.25 and the total axial force is 15 kN. Calculate the power transmitting capacity of the clutch plate at 500 rpm using: (i) Uniform wear theory and, (ii) Uniform pressure theory.**(13M)(May/June 2013)**BTL5 |
| 6 | A multi plate clutch with both sides effective transmits 30 kW at 360 rpm. Inner and outer radii of the clutch discs are 100 mm and 200 mm respectively. The effective coefficient of friction is 0.25. An axial load of 600 N is applied. Assuming uniform wear conditions, find the number of discs required and the maximum intensity of pressure developed**. (15M)(May/June 2016)**BTL5 |
| 7 | A multi plate clutch steel on bronze is to transmit 6 kW power at 750 rpm. The inner radius of contact surface is 4 cm and outer radius is 7 cm. The clutch plates operate in oil, so the coefficient of friction is 0.1. The average pressure is 0.5 N/mm2. Determine (i) the total  number of steel and bronze friction discs, (ii) actual axial force required, (iii) actual average pressure, (iv) actual maximum pressure**.(15M)(Nov/Dec 2016)**BTL5 |