SIDDHARTH INSTITUTE OF ENGINEERING &TECHNOLOGY :: PUTTUR
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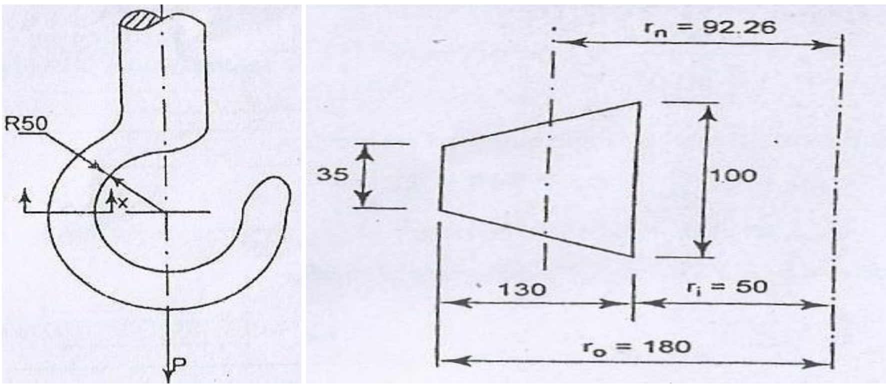
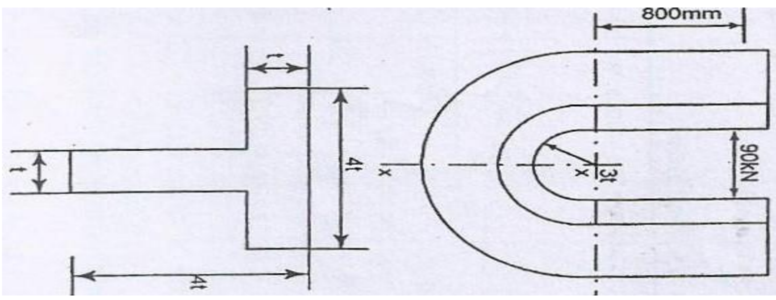
QUESTION BANK (DESCRIPTIVE)

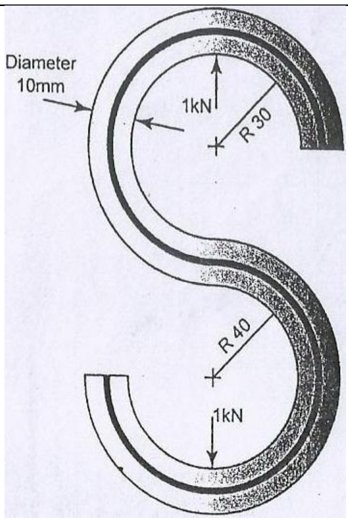
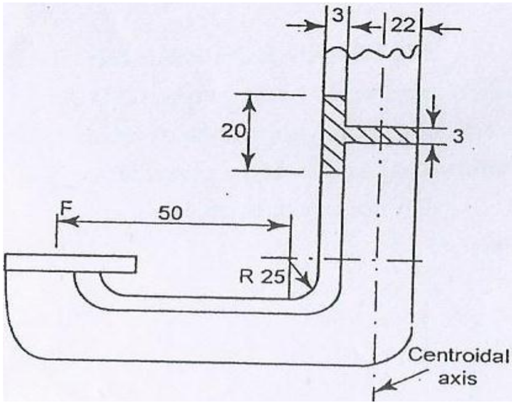
Subject with Code : Design of Machine Elements-II (19ME0318) **Course & Branch**: B.Tech - ME

Year & Sem: III-B.Tech & II SEM **Regulation:** R19

UNIT I

DESIGN OF CURVED BEAMS & POWER TRANSMISSION SYSTEMS

1.	(a). Differentiate the straight and curved beams? (b). A crane hook has a section, which for the purpose of analysis is considered trapezoidal as shown in fig. it is made of plain carbon steel with an yield strength of 350Mpa in tension. Determine the load capacity of the hook for a factor of safety 3.  	L2 L5	CO1 CO1	2M 10M
2.	A punch press of capacity 90KN has a c-frame of T- cross section as shown in fig. The frame is made of a material with an ultimate tensile stress of 400MPa for a factor of safety of 3.5, determine the dimensions of the frame.  	L5	CO1	12M
3.	An open S link shown in fig. is made of steel rod of diameter 12mm. Determine the maximum tensile and shear stress.	L5	CO1	12M

				
4.	A C- clamp is to bear the force' F' applied on to it. It has a T-section as shown in fig. if the maximum tensile strength in the clamp is limited to 130MPa. Find 'F'. 	L5	CO1	12M
5.	The horizontal section of crane hook is symmetrical trapezium 120 mm deep, the inner width being 90 mm and outer width being 30 mm. The hook is made of plain carbon steel 45C8 (σ_{yt}= 380 N/mm^2) and the factor of safety is 3.5. Determine the load carrying capacity of the hook. Also draw the crane hook and show the location at which maximum stress is acting.	L4	CO1	12M
6.	A rope drive is to transmit 250 kW from a pulley of 1.2 m diameter, running at a speed of 300 r.p.m. The angle of lap may be taken as π radians. The groove half angle is 22.5°. The ropes to be used are 50 mm in diameter. The mass of the rope is 1.3 kg per metre length and each rope has a maximum pull of 2.2 Kn, the coefficient of friction between rope and pulley is 0.3.Determine the number of ropes required. If the overhang of the pulley is 0.5 m, suggest suitable size for the pulley shaft if it is made	L5	CO1	12M

	of steel with a shear stress of 40 Mpa.			
7.	Two shafts whose centres are 1 metre apart are connected by a V-belt drive. The driving pulley is supplied with 95 Kw power and has an effective diameter of 300 mm. It runs at 1000 r.p.m. while the driven pulley runs at 375 r.p.m. The angle of groove on the pulleys is 40°. Permissible tension in 400 mm^2 cross-sectional area belt is 2.1 Mpa. The material of the belt has density of 1100 kg / m^3. The driven pulley is overhung, the distance of the centre from the nearest bearing being 200 mm. The coefficient of friction between belt and pulley rim is 0.28. Estimate: 1. The number of belts required ; and 2. Diameter of driven pulley shaft, if permissible shear stress is 42 Mpa.	L5	CO1	12M
8.	A belt drive consists of two V-belts in parallel, on grooved pulleys of the same size. The angle of the groove is 30°. The cross-sectional area of each belt is 750 mm^2 and μ = 0.12. The density of the belt material is 1.2 Mg / m^3 and the maximum safe stress in the material is 7 Mpa. Calculate the power that can be transmitted between pulleys of 300 mm diameter rotating at 1500 r.p.m. Find also the shaft speed in r.p.m. at which the power transmitted would be a maximum.	L5	CO1	12M
9.	An open belt connects two flat pulleys. Pulley diameters are 300 mm and 450mm and the corresponding angles of cap are 160^0 and 210^0 . the smaller pulley runs at 200rpm, μ=0.25. it is found that the belt is on the point of slipping when 3kw is transmitted. To increase the power transmitted two alternatives are suggested., namely (i) increase the initial tension by10% and (ii) increasing μ by 10% by the application of a suitable dressing to the belt. Which of these two methods would be more effective ? find the percentage increase in power possible in each case.	L4	CO1	12M
10.	Design a horizontal belt drive for a centrifugal blower, the belt driven at 600rpm by a 15kw, 1750rpm electric motor. The centre distance is twice the diameter of the larger pulley. The density of the belt material=1500kg/m^3 maximum allowable stress =4MPa. μ_1=0.5 (motor pulley), μ_2=0.4 (blower pulley); peripheral velocity of the belt=20m/s. Determine the following: i. Pulley diameters	L6	CO1	12M

	ii. Belt length iii. Cross sectional area of the belt iv. Minimum initial tension for operation without slip			

UNIT II

Design of sliding contact & rolling contact Bearings

1.	Design a journal bearing for a centrifugal pump with the following data. Diameter of journal =150mm Load on bearing =40kN Speed of journal =900 RPM	L6	CO2	12M
2.	Design a journal bearing for centrifugal pump from the following data: Load on the journal = 20 kN Speed of the journal = 900 rpm Type of oil SAE 10 for which absolute viscosity at 55°C = 17 centipoises Ambient temperature of oil = 15.5°C Maximum bearing pressure for the pump = 1.5 N/mm2 Calculate also the mass of the lubricating oil required for artificial cooling to rise in temperature of the oil limited to 10°C. Heat dissipation coefficient = 12.2 kN/m^2/°C	L5	CO2	12M
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 rpm 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: (i) The amount of artificial cooling required. (ii) 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.	L6	CO2	12M
4.	Following data is given for 360^0 hydrodynamic bearings: journal	L5	CO2	12M

	diameter =100 mm, radial clearance =0.12mm, radial load =50kN,bearing length =100 mm, journal speed =1440rpm and viscosity of lubricant = 16CP. Calculate (i) minimum film thickness (ii) coefficient of friction and (iii) power lost in friction.			
5.	Design a journal bearing for centrifugal pump for the following data: Load on the journal = 12kN Diameter of the journal =75mm Speed=1440 rpm Atmosphere temperature =16^{0}C Operating temperature=60^{0}C Absolute viscosity of oil at 60^{0}C = 23 centipoise	L6	CO2	12M
6.	A 70mm machine shaft is to be supported at the ends. It operates continuously for 8hrs per day,320 days per year for 8 years. The load and speed cycle for one of the bearings are given below. Select the bearing.	L6	CO2	12M

S.No	Fraction of cycle	Radial load,N	Thrust load,N	Speed, rpm	X	Y	Z
1	0.25	3500	1000	600	0.56	1.2	1.5
2	0.25	3000	1000	800	0.56	1.2	1.5
3	0.5	4000	2000	900	0.56	1.4	1.5

7.	Select a suitable spherical roller bearing from SKF series 222C to support a radial load of 4kN and axial load of 2kN. Minimum life required is 10000 hrs at 1000 rpm. For this select bearing find (i) The expected life under the given loads (ii) The equivalent load that can be supported with a probability of survival of 95% with 10000 hours.	L6	CO2	12M
8.	The radial load on a roller bearing varies as follows a load of 50 kN is acting 20% of time at 500 rpm and a load of 40kN is acting 50% of the time at 600 rpm. In the remaining time the load varies from 40kN to 10kN linearly at 700 rpm. Select a roller bearing from NU22 series for a life of at least 4000 hours. The operating temperature is 175^{0}C.	L5	CO2	12M

9.	The ball bearing for the drilling machine spindle is rotating at 3000rpm. It is subjected to radial load of 2500N and an axial load of 1500N. It is to work 50 hours per week for one year. Design a suitable bearing if the diameter of the spindle is 40mm.	L6	CO2	12M
10.	The ball bearing for the drilling machine spindle of 40mm diameter is rotating at 3000rpm. It is subjected to radial load of 2000N and an axial load of 750N. It is to work 45 hours per week for one year. Select and specify a suitable ball bearing.	L6	CO2	12M

UNIT III
DESIGN OF IC ENGINES PARTS

1.	The following data is given for the piston of a four stroke diesel engine: Cylinder bore = 250 mm Material of piston rings = Gray cast iron Allowable tensile stress=100N/mm^2 Allowable radial pressure on cylinder wall = 0.03 MPa Thickness of piston head = 42 mm and No of piston rings = 4 Calculate: (i) Radial with of piston rings. (ii) Axial thickness of piston rings. (iii) Gap between the ends of piston rings before and after assembly. (iv) Width of the top land. (v) Width of the ring grooves. (vi) Thickness of the piston barrel and thickness of the barrel open end.	L5	CO3	12M
2.	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 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 rpm Tensile stress for cast iron (σ_t) = 38 MPa. Any other data required for the design may be assumed.	L6	CO3	12M
3.	(a) Enumerate the qualities of good cylinder liners.	L2	CO3	6M

	(b) What is the function of piston? Explain piston troubles.	L1	CO3	6M
4.	(a) Explain about cylinder liners. What are the advantages of dry liners? (b)A four stroke diesel engine has the following specifications: Brake power = 6 kW, speed = 1000 rpm, indicated mean effective pressure = 0.45 N/mm^2, mechanical efficiency = 85%. Determine: (i) Bore and length of the cylinder. (ii) Thickness of cylinder head. (iii) Size of studs for the cylinder head.	L2 L5	CO3 CO3	4M 8M
5.	Design a trunk type CI piston for an IC engine having a diameter of 100mm and length of 150mm. the max pressure is 3.5MPa. Maximum permissible tension for CI for the design and head thickness is 30MPa and for the piston ring material 45MPa, bearing pressure for the piston pin should not exceed 200MPa.	L6	CO3	12M
6.	A connecting rod for a high speed IC engine uses following data: Cylinder bore = 125 mm Length of CR = 300 mm Maximum gas pressure = 3.5 MPa Length of stroke = 125 mm Mass of the reciprocating parts = 1.6 kg Engine speed = 2200 rpm Calculate: (i) Size of cross section of the connection rod. (ii) Sizes of the big and small end bearings.	L5	CO3	12M
7.	(a)Explain why torsional vibrations are dangerous. (b)Explain reasons for the failure of a crank shaft.	L2 L2	CO3 CO3	6M 6M
8.	Design a I-section of a connecting rod for an I.C engine using the following data: Piston diameter = 125 mm Stroke = 150 mm Length of connecting rod = 300 mm Gas pressure = 5 N/mm^2 Speed of engine = 1200 rpm Factor of safety = 5 and material is steel 35 NiCr60.	L6	CO3	12M

9.	Design overhung crank shaft for a 0.25 m × 0.4 m horizontal gas engine, explosion pressure2.38 MPa, weight of flywheel 16 kN, total belt pull 3 kN. When the crank is at 300, the torque on the crank shaft is maximum and the gas pressure at this position is 1.015 MPa. Length of the connecting rod is 0.95 m.	L6	CO3	12M
10.	Design a connecting rod for an IC engine running at 1800rpm and developing a maximum pressure of 3.15 N/mm^2 the diameter of piston is 100mm, mass of the reciprocating parts per cylinder is 2.25kg, length of connecting rod is 380mm, stroke of piston is 190mm and compression ratio 6:1. Take a factor of safety of 6 for the design. Take length to diameter ratio for big end bearing as 1.3 and small end bearing as 2, corresponding bearing pressure as 10N/mm^2 and 15 N/mm^2. The density of the material rod may be taken as 8000kg/m^3 and the allowable stress in the bolts as 60 N/mm^2 and in cap as 80 N/mm^2. The rod is to be of I-section for which you can choose your own proportions. Draw a neat sketch. Use Rankin's formulae for which the numerator constant may be taken as 320 N/mm^2 and denominator constant as 1/7500.	L6	CO3	12M

UNIT IV
DESIGN OF MECHANICAL SPRINGS

1.	A compression spring made of alloy steel of coil diameter 75 mm and spring index 6.0, number of active coil 20 is subjected to a load of 1.2 kN. Calculate: (i) The maximum stress developed in the coil. (ii) The deflection produced. (iii) The spring rate.	L5	CO4	12M
2.	It is required to design a helical compression spring with plain ends, made of cold drawn plain carbon steel, for carrying a maximum pure static force of 1000 N. The ultimate tensile strength and modulus of rigidity for spring material are 1430 N/mm^2 and 85 N/mm^2 respectively. The spring rate is 48 N/mm. If spring index is 5, determine: (i) Wire diameter. (ii) Total number of coils. (iii) Free length and (iv) Pitch. Draw a neat sketch of spring with necessary dimensions.	L5	CO4	12M
3.	Design a valve spring for an automobile engine when engine valve is closed, the spring produces a force of 44 N and when valve open,	L6	CO4	12M

	produces a force of 54 N. The spring must fit over the valve bush which has an outside diameter of 20 mm and must go inside a space of 35 mm. The lift of the valve is 6 mm. The spring index is 12. The allowable stress may be taken as 325 N/mm^2. Modulus of rigidity may be assumed as 80 × 10^3 N/mm^2.			
4.	A semi-elliptical laminated vehicle spring to carry a load of 6000 N is to consist of seven leaves 65 mm wide, two of the leaves extending the full length of the spring. The spring is to be 1.1 m in length and attached to the axle by two U-bolts 80 mm apart. The bolts hold the central portion of the spring so rigidly that they may be considered equivalent to a band having a width equal to the distance between the bolts. Assume a design stress for spring material as 350 MPa. Determine: (i) Thickness of leaves. (ii) Deflection of spring. (iii) Diameter of eye. (iv) Length of leaves. (v) Radius to which leaves should be initially bent.	L5	CO4	12M
5.	(a) Explain what you understand by A.M. Wahl's factor and state its importance in the design of helical springs. (b) A mechanism used in printing machinery consists of a tension spring assembled with a preload of 30 N. The wire diameter of spring is 2 mm with a spring index of 6. The spring has 18 active coils. The spring wire is hard drawn and oil tempered having following material properties: Design shear stress = 680 MPa, Modulus of rigidity = 80 kN/mm^2. Determine: (i) The initial torsional shear stress in the wire. (ii) Spring rate. (iii) The force to cause the body of the spring to its yield strength.	L2 L5	CO4 CO4	4M 8M
6.	(a)What is the function of a spring? (b) A helical spring is made from a wire of 6 mm diameter and has outside diameter of 75 mm. If the permissible shear stress is 350 MPa and modulus of rigidity 84 kN/mm^2, find the axial load which the spring can carry and the deflection per active turn.	L1 L5	CO4 CO4	3M 9M
7.	A bumper consisting of two helical steel springs of circular section brings to rest, a railway wagon of mass 1500 kg and moving at 1.2 m/s. While doing so, the springs are compressed by 150 mm. The mean diameter of the coils is 6 times the wire diameter. The permissible shear stress is 400 MPa. Determine:	L5	CO4	12M

	(i) Maximum force on each spring. (ii) Wire diameter of the spring. (iii) Mean diameter of the coils and (iv) Number of active coils. Take G = 0.84 x 105MPa.			
8.	Design a close coiled helical compression spring for a service load ranging from 2250 N to 2750 N. The axial deflection of the spring for the load range is 6 mm. Assume a spring index of 5. The permissible shear stress intensity is 420 MPa and modulus of rigidity, G = 84 kN/mm^2.	L6	CO4	12M
9.	(a)Classify springs according to their shapes. Draw neat sketches indicating in each case whether stresses are induced by bending or by torsion. (b)Design a spring for a balance to measure 0 to 1000 N over a scale of length 80 mm. The spring is to be enclosed in a casing of 25 mm diameter. The approximate number of turns is 30. The modulus of rigidity is 85 kN/mm^2. Also calculate the maximum shear stress induced.	L4 L6	CO4 CO4	4M 8M
10.	Design and draw a valve spring of a petrol engine for the following operating conditions : Spring load when the valve is open = 400 N Spring load when the valve is closed = 250 N Maximum inside diameter of spring = 25 mm Length of the spring when the valve is open= 40 mm Length of the spring when the valve is closed= 50 mm Maximum permissible shear stress = 400 MPa	L6	CO4	12M

UNIT V
DESIGN OF GEARS

1.	A compressor running at 300 rpm is driven by 15kW, 1200rpm motor through 20^0 full depth involute gears. The centre distance is 375mm. choose the suitable materials for the pinion and gear, design the drive.	L5	CO5	12M
2.	In a spur gear drive for a rock crusher, the gears are made of case hardened alloy steel. The pinion is transmitting 18 kW at 1200 rpm with a gear ratio of 3.5. The gear is to work 8 hours/day for 3 years. Design the drive.	L6	CO5	12M

3.	A pair of straight spur gears is required to reduce the speed of shaft from 500 to 100 rpm while continuously running 12hr per day. The pinion is of 40C8 steel and has 20 teeth. The wheel is of cast iron of grade FG200 and has 100 teeth. The gears are of 8mm module, 100 mm face width and 20^0 pressure angle. Calculate power rating.	L5	CO5	12M
4.	A pair of gears connecting parallel shafts is to transmit 415 N-m torsional moment at 2800 rpm of the pinion. The teeth are to be 20^0 stub of heat treated alloy steel. The width of face is 38mm. The driver gear rotates at 1800 rpm. Select necessary module and check for wear.	L5	CO5	12M
5.	A pair of gears is to be designed to transmit 30kW for a pinion speed of 1000 rpm and a speed ratio of 5. Design the gear train.	L6	CO5	12M
6.	A helical gear set used in a paper pulping machine connects the driving motor to the blade shaft. A power of 20kW is transmitted by the motor at 1600rpm while the blade shaft runs at 400rpm. Due to space restrictions the center distance between the gears is kept at 500mm. choosing suitable materials for the gears design the 20^0 full depth involute helical gears with a helix angle of 25^0.	L5	CO6	12M
7.	A pair of helical gears are to transmit a power of 15 kW. The teeth are 20^0 stub in diametral plane and have helix angle of 45^0. The pinion runs at 10,000 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 assuming σ_{es} = 618 MPa.	L5	CO6	12M
8.	A compressor running at 350 rpm is driven by 5 kW, 1400 rpm motor through 20^0 full depth spur gears. The motor pinion is to be of C30 forged steel hardened and tempered, and the driven gear is to be of cast iron grade 35. Assuming medium shock condition, design the gear drive completely. Take minimum number of teeth is 18 for the pinion. The gears are working for one shift per day in an industrial atmosphere and to work for two years before their replacement.	L6	CO6	12M
9.	A pair of helical gears in a milling machine is used to transmit 4.5 kW at 1000 rpm of the pinion and the velocity ratio is 3:1. The helix angle of the	L6	CO6	12M

	gear is 15^0 and both gears are made of steel C45. The gears are 20^0 FDI and the pinion is to have minimum of 20 teeth. The gear is to work 8 hrs/day for 3 years. Design the helical gears. Take the required hardness for both gears is more than 350 BHN.			
10.	A motor shaft rotating at 1500 r.p.m. has to transmit 15 kW to a low speed shaft with a speed reduction of 3:1. The teeth are $14\frac{1}{2}^0$ involute with 25 teeth on the pinion. Both the pinion and gear are made of steel with a maximum safe stress of 200 MPa. A safe stress of 40 MPa may be taken for the shaft on which the gear is mounted and for the key. Design a spur gear drive to suit the above conditions. Also sketch the spur gear drive. Assume starting torque to be 25% higher than the running torque.	L6	CO6	12M

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