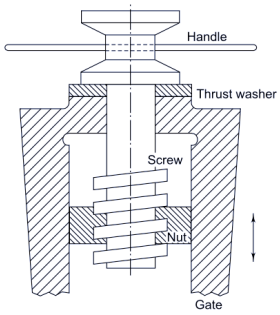
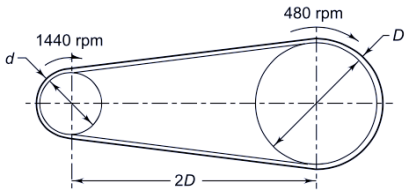
QUESTION BANK

Question No	Questions	PO Attainment	BT
	UNIT 1 – DESIGN OF INTERNAL COMBUSTION ENGINE PARTS		
	PART-A (Two Marks Questions)		
1	What are the functions of engine cylinder?	PO1	R
2	What are the advantages of cylinder liner?	PO1	R
3	What do you understand by 'bore' of cylinder?	PO1	U
4	What are the functions of piston?	PO1	R
5	Name two criteria for calculating the thickness of piston head.	PO1	R
6	Why is piston clearance necessary? What is its usual value?	PO1, PO2	U, AP
7	What are the functions of piston ribs?	PO1	R
8	What is the function of the cup on piston head?	PO1	R
9	What are the functions of compression piston rings?	PO1	R
10	What is the function of connecting rod?	PO1	R
11	What are the forces acting on the connecting rod?	PO1	R
12	Why are connecting rods made of I sections?	PO1, PO2	A
13	What is the difference between centre and overhung crankshafts?	PO1	R
14	Why is the area of inlet valve port more than that of an exhaust valve?	PO1, PO2	A
15	What is the purpose of valve spring?	PO1	R
16	What's the difference between a center crankshaft and side crankshaft?	PO1	U
17	State the function of a piston pin	PO1	R
18	What is the criterion for design of push rod?	PO1	E
19	Where do you use centre crankshafts?	PO1	R
20	What is the manufacturing method for crankshaft?	PO1	R
	PART–B (Ten Marks questions)		
1	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 (Sut = 200 N/mm2) and the factor of safety is 5. Studs are used to fix the cylinder head to the cylinder and obtain a leakproof joint. They are made of steel FeE 250 (Syt = 250 N/mm2) and their factor of safety is 5. Design the cylinder head and the studs used to connect the head to the cylinder.	PO1, PO2, PO4	C
2	The cylinder of a four-stroke diesel engine has the following specifications: Brake power = 7.5 kW Speed = 1400 rpm Indicated mean effective pressure = 0.35 MPa Mechanical efficiency = 80% Maximum gas pressure = 3.5 MPa .The cylinder liner and head are made of grey cast iron FG 260 (Sut = 260 N/mm2 and m = 0.25). The studs are made of plain-carbon steel 40C8 (Syt = 380 N/mm2). The factor of safety for all parts is 6. Design: 1. Cylinder liner 2. Cylinder head 3. Studs to connect head to the cylinder	PO1, PO2, PO4	C
3	What is the use of a Piston pin? Draw a rough diagram depicting the forces acting on piston pin. If you are asked to design a piston pin how will you proceed?	PO1, PO2, PO3	A

4	The following data is given for a four-stroke diesel engine: Cylinder bore = 250 mm Length of stroke = 300 mm Speed = 600 rpm Indicated mean effective pressure = 0.6 MPa Mechanical efficiency = 80% Maximum gas pressure = 4 MPa Fuel consumption = 0.25 kg per BP per h Higher calorific value of fuel = 44 000 kJ/kg Assume that 5% of the total heat developed in the cylinder is transmitted by the piston. The piston is made of grey cast iron FG 200 (Sut = 200 N/mm2 and k = 46.6 W/m/°C) and the factor of safety is 5. The temperature difference between the centre and the edge of the piston head is 220°C. a. Which criterion decides the thickness of the piston head and what is it's value? b. Are ribs and cups necessary for the given arrangement? If they are, then calculate their dimensions.	PO1, PO2, PO4	E, A
5	a. The following data is given for the piston of a four-stroke diesel engine: Cylinder bore = 250 mm Maximum gas pressure = 4 MPa Allowable bearing pressure for skirt = 0.4 MPa Ratio of side thrust on liner to maximum gas load on piston = 0.1 Width of top land = 45 mm Width of ring grooves = 6 mm Total number of piston rings = 4 Axial thickness of piston rings = 7 mm Calculate: 1. length of the skirt; and 2. length of the piston. b. Design a piston pin for following data corresponding to the piston of a four-stroke diesel engine: Cylinder bore = 250 mm Maximum gas pressure = 4 MPa Bearing pressure at small end of connecting rod = 15 MPa Length of piston pin in bush of small end = 0.45D Ratio of inner to outer diameter of piston pin = 0.6 Mean diameter of piston boss = 1.4 * outer diameter of piston pin Allowable bending stress for piston pin = 84 N/mm2	PO1, PO2, PO4	E, C
6	Design a cast iron piston for a single acting four-stroke diesel engine with the following data: Cylinder bore = 300 mm Length of stroke = 450 mm Speed = 300 rpm Indicated mean effective pressure = 0.85 MPa Maximum gas pressure = 5 MPa Fuel consumption = 0.30 kg per BP per h Higher calorific value of fuel = 44 000 kJ/kg Assume suitable data if required and state the assumptions you make.	PO1, PO2, PO4	C
7	a. What do you know about the buckling phenomenon in a connecting rod? Explain it in detail. b. Based on buckling considerations a particular cross-section of beam is preferred. Which is that section and why is it chosen over others? Justify your answer.	PO1, PO2, PO3	AP, A, E

8	The following data is given for the connecting rod of a diesel engine: Cylinder bore = 85 mm Length of connecting rod = 350 mm Maximum gas pressure = 3 MPa Factor of safety against buckling failure = 5 (l/d) ratio for piston pin bearing = 1.5 (l/d) ratio for crank pin bearing = 1.25 9Allowable bearing pressure for piston pin bearing = 13 MPa Allowable bearing pressure for crank pin bearing = 11 MPa Length of stroke = 140 mm Mass of reciprocating parts = 1.5 kg Engine speed = 2000 rpm Thickness of bearing bush = 3 mm Material of cap = steel 40C8 Yield strength of cap material = 380 N/mm2 Factor of safety for cap = 4 Material of bolts = chromium molybdenum steel Yield strength of bolt material = 450 N/mm2 Factor of safety for bolts = 5 Density of connecting rod = 7800 kg/m3 Calculate: 1. dimensions of the cross-section of connecting rod; 2. dimensions of small and big end bearings; 3. nominal diameter of bolts for the cap;	PO1, PO2, PO4	A, AP
9	When spoken about design of a centre crankshaft, there are two positions that the crank will be that are considered. What are those positions related to the crank? When will the crank have maximum bending moment? You are asked to design a centre crankshaft considering that the maximum moment experienced by it bending moment. How will you design?	PO1, PO2, PO3	A, AP
10	Design a centre crankshaft when it is subjected to maximum torsional moment.	PO1, PO2, PO3	A

Question No	Questions	PO Attainment	BT
	UNIT 2 – DESIGN OF POWER SCREWS AND TRANSMISSION SYSTEMS		
	PART-A (Two Marks Questions)		
1	What is power screw? What are the applications of power screws?	PO1	R
2	What are the advantages and disadvantages of power screws?	PO1	R
3	Why are *V* threads not used in power screws?	PO1, PO2	A
4	What are the advantages of square threads over trapezoidal threads?	PO1	R
5	What are the applications of trapezoidal threads?	PO1	R
6	How will you designate multiple-start trapezoidal threads?	PO1	R
7	What is 'self-locking' of power screw? What is the condition for self-locking?	PO1, PO2	AP
8	What is differential screw?	PO1	R
9	What is compound screw?	PO1	R
10	What are the advantages of chain drives?	PO1	R
11	What are the five parts of roller chain?	PO1	R
12	What is the polygonal action in roller chain? How will you reduce it?	PO2	U
13	In chain drives, the sprocket has odd number of teeth and the chain has even number of links. Why?	PO1, PO2	A, AP
14	Why are belt drives called 'flexible' drives?	PO1	R
15	What are the advantages of leather belts over fabric rubber belts?	PO1	R
16	What do you understand by single-ply and double-ply belts?	PO1	R
17	State the law of belting.	PO1	R
18	What is belt rating?	PO1	R
19	What is Lang's-lay wire rope?	PO1	R
20	Give practical applications of wire rope.	PO1	R
	PART–B(Ten Marks questions)		
1	What changes happen to the torque requirement of a power screw when you are lifting a load Vs when you are lowering the load? Explain in detail.	PO1, PO2, PO3	A, E
2	What is meant by a Self-locking screw? What are it's applications? When will a self-locking screw attain maximum efficiency and what is its value?	PO1, PO2, PO3	R, U, A
3	The construction of a gate valve used in high-pressure pipeline is shown in Fig.  The screw is rotated in its place by means of the handle. The nut is fixed to the gate. When the screw rotates, the nut along with the gate moves downward or upward depending upon the direction of rotation of the screw. The screw has single-start square threads of 40 mm outer diameter and 7 mm pitch. The weight of the gate is 5 kN. The water pressure in the pipeline induces frictional resistance between the gate and its seat. The resultant frictional resistance in the axial direction is 2 kN. The inner and outer diameters of thrust washer are 40 and 80 mm respectively. The values of coefficient of friction at the threads and at the washer are 0.15 and 0.12 respectively. The handle is rotated by the two arms, each exerting equal force at a radius of 500 mm from the axis of the screw. Calculate 1 the maximum force exerted by each arm when the gate is being raised; 2 the maximum force exerted by each arm when the gate is being lowered; 3 the efficiency of the gate mechanism; and the length of the nut, if the permissible bearing pressure is 5 N/mm^2.	PO1, PO2, PO4	A, AP

4	a) Plot a graph of efficiency v/s helix angle, which varies from 0 to 60°, for a square- threaded screw. The coefficient of friction at the threads is 0.10 and the collar friction is negligible. b) A triple-threaded power screw, used in a screw jack, has a nominal diameter of 50 mm and a pitch of 8 mm. The threads are square and the length of the nut is 48 mm. The screw jack is used to lift a load of 7.5 kN. The coefficient of friction at the threads is 0.12 and the collar friction is negligible. Calculate: (i) the principal shear stress in the screw body; (ii) the transverse shear stresses in the screw and the nut; and the unit bearing pressure. State whether the screw is self-locking	PO1, PO2, PO3, PO4	R, U, A
5	If you are given the following values for a flat belt drive and asked to find the relationship that links them, how will your approach be? belt tension in the tight side in N is P_1 ; belt tension in the loose side in N is P_2 ; m = mass of the one meter length of belt (kg/m) ; v = belt velocity in m/s; f = coefficient of friction; α = angle of wrap for belt in radians	PO1, PO2, PO3	A, AP
6	Design a belt drive transmitting 15 kW of power is shown in Fig. The centre distance between the pulleys is twice the diameter of the bigger pulley. The belt should operate at a velocity of 20 m/s approximately and the stresses in the belt should not exceed 2.25 N/mm2. The density of leather is 0.95 g/cc and the coefficient of friction is 0.35. The thickness of the belt is 5 mm. 	PO1, PO2, PO4	C
7	Explain how a chain drive is denoted by explaining each term involved. Explain in detail the polygonal effect experienced in a chain drive.	PO1, PO2	R, U
8	It is required to design a chain drive to connect a 12 kW, 1400 rpm electric motor to a centrifugal pump running at 700 rpm. The service conditions involve moderate shocks. 1) Select and design a proper roller chain drive 2) Specify the correct centre distance between the axes of sprockets. Assume relevant data.	PO1, PO2, PO4	C
9	6 X19 wire ropes with fibre core and nominal diameter of 10 mm are used for a hoist. The tensile designation of wires is 1770. The mass of the wire rope is 34.6 kg per l00 m length, while the breaking load is 54 kN. The weight of the hoist along with the material is 10 kN, which is raised through a distance of 3 m. The maximum acceleration during the operation is limited to 1 m/s^2. Neglecting bending stresses and assuming a preliminary factor of safety of 10, determine the required number of wire ropes.	PO1, PO2, PO4	C
10	It is required to select a 6 X 19 wire rope with 1570 as tensile designation for a hoist on the basis of long life. The weight of the hoist along with the material is 5 kN. It is to be raised from a depth of 100 m. The maximum speed of 5 m/s is attained in 5 s. Determine the size of the wire rope and the sheave diameter for long life on the basis of the fatigue as failure criterion. What is the factor of safety of this wire rope under static conditions?	PO1, PO2, PO4	C

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	UNIT 3 – ENERGY STORING ELEMENTS		
	PART-A (Two Marks Questions)		
1	What are the applications of spring?	PO1	R
2	What type of stress is induced in helical compression spring?	PO1	R
3	Distinguish between closely coiled and open- coiled helical springs.	PO1	R
4	What are the applications of multi-leaf spring?	PO1	R
5	What is the spring index?	PO1	R
6	What is stiffness of spring?	PO1	R
7	What are active coils of spring & inactive coils of spring?	PO1	R
8	What is the Wahl factor? Why is it used?	PO1	R, U
9	What is concentric spring?	PO1	R
10	What are graduated-length and full-length leaves in multi-leaf spring?	PO1	R
11	What is nip of leaf spring? What is the objective of nipping of leaf spring?	PO1	R
12	What is the function of flywheel?	PO1	R
13	What is the coefficient of speed fluctuation?	PO1	R
14	What is the coefficient of fluctuation of energy?	PO1	R
15	Why flywheels are used in presses?	PO1, PO2	R, A
16	What type of stress is induced in helical torsion spring?	PO1	R, AP
17	What are the objectives of series and parallel connections of springs?	PO1	R
18	What is surge in spring?	PO1	R
19	What are the advantages of spiral spring?	PO1	R
20	Comment about the stiffness of spring system when connected in series and parallel.	PO1, PO2	U
	PART–B(Ten Marks questions)		
1	It is required to design a helical compression spring for the valve mechanism. The axial force acting on the spring is 300 N when the valve is open and 150 N when the valve is closed. The length of the spring is 30 mm when the valve is open and 35 mm when the valve is closed. The spring is made of oil-hardened and tempered valve spring wire and the ultimate tensile strength is 1370 N/mm^2 The permissible shear stress for the spring wire should be taken as 30% of the ultimate tensile strength. The modulus of rigidity is 81 370 N/mm2. The spring is to be fitted over a valve rod and the minimum inside diameter of the spring should be 20 mm. Design the spring by mentioning at least 6 parameters pertaining to the spring. Assume that the clearance between adjacent coils or clash allowance is 15% of the deflection under the maximum load.	PO1, PO2, PO4	C
2	A helical tension spring is used in the spring balance to measure the weights. One end of the spring is attached to the rigid support while the other end, which is free, carries the weights to be measured. The maximum weight attached to the spring balance is 1500 N and the length of the scale should be approximately 100 mm. The spring index can be taken as 6. The spring is made of oil-hardened and tempered steel wire with ultimate tensile strength of 1360 N/mm2 and modulus of rigidity of 81 370 N/mm2. The permissible shear stress in the spring wire should be taken as 50% of the ultimate tensile strength. Design the spring and calculate (i) wire diameter; (ii) mean coil diameter; (iii) number of active coils; (iv) required spring rate; and (v) actual spring rate	PO1, PO2, PO4	A, E
3	A railway wagon moving at a velocity of 1.5 m/s is brought to rest by a bumper consisting of two helical springs arranged in parallel. The mass of the wagon is 1500 kg and the springs are compressed by 150 mm in bringing the wagon to rest. The spring index can be assumed as 6. The springs are made of oil-hardened and tempered steel wire with ultimate tensile strength of 1250 N/mm2 and modulus of rigidity of 81 370 N/mm2. Design the spring and mention all the required parameter values.	PO1, PO2, PO4	C
4	A concentric spring consists of two helical compression springs one inside the other. The outer spring exceeds the inner one by 15 mm in free length. The wire diameter and mean coil diameter of the springs are 5 and 30 mm for the inner one and 6 and 36 mm for the outer spring respectively. The number of active coils in the inner and outer springs can be taken as 8 and 10 respectively. Assuming both the springs are made of	PO1, PO2, PO4	AP, E

<table>
<tr><td></td><td>same material with modulus of rigidity of 81370 N/mm2. Calculate the following parameters when the composite spring is subjected to a maximum axial force of 1000 N :

1) the compression of each spring;
2) the force transmitted by each spring; and
3) the maximum torsional shear stress induced in each spring</td><td></td><td></td></tr>
<tr><td>5</td><td>Design a helical compression spring for minimum weight for an exhaust valve mechanism which is initially compressed with a pre-load of 375 N. When the spring is further compressed and the valve is fully opened, the torsional shear stress in the spring wire should not exceed 750 N/mm2. Due to space limitations, the outer diameter of the spring should not exceed 42 mm.</td><td>PO1, PO2, PO4</td><td>C</td></tr>
<tr><td>6</td><td>Explain what is a flywheel and governor by highlighting the salient features of both. Derive an expression for the Energy fluctuation in a flywheel using Torque Vs Crank angle diagram.</td><td>PO1, PO2, PO3</td><td>R, U, AP</td></tr>
<tr><td>7</td><td>The torque developed by an engine is given by the following equation:

$T = 14250 + 2200 \sin 2\theta - 1800 \cos 2\theta$

The resisting torque of the machine is constant throughout the work cycle. The coefficient of speed fluctuations and engine speed are 0.01and 150 rpm respectively. Design a flywheel which is 50 mm thick and is in the shape of a solid circular disk made of steel. The mass density of steel can be taken as 7800 kg/m3.</td><td>PO1, PO2, PO4</td><td>A, AP</td></tr>
<tr><td>8</td><td>Design a rimmed flywheel of square cross section made of cast iron FG 220 (ρ = 7150 kg/m3) for an engine consisting of three single acting cylinders with their cranks set equally at 120° to each other. The torque-crank angle diagram for each cylinder consists of a triangle with the following values:

The engine runs at a mean speed of 240 rpm and the coefficient of speed fluctuations is limited to 0.03. The resisting torque of the machine is constant throughout the work cycle. From considerations of space, the mean radius of the rim should not exceed 0.25 m. The contribution of rim to the total required moment of inertia can be your own assumption.

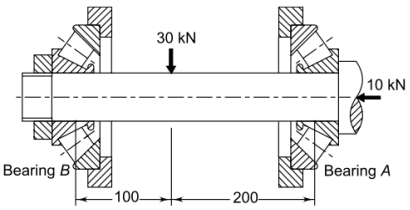
<table>
<tr><td>Crank angle(deg)</td><td>0</td><td>60</td><td>180</td><td>180-360</td></tr>
<tr><td>Torque(N-m)</td><td>0</td><td>300</td><td>0</td><td>0</td></tr>
</table>
</td><td>PO1, PO2, PO4</td><td>C</td></tr>
<tr><td>9</td><td>Design a rectangular rimmed flywheel made of grey cast iron FG 200(ρ = 7100 kg/m3) with ratio of width to thickness as 1.5 when the torque developed by a three- crank engine is given by the following expression:

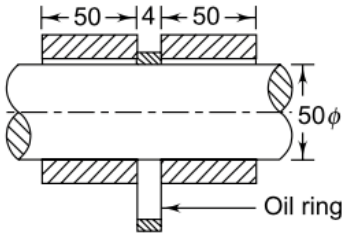
$Ti = 19000 + 7000 \sin (3\theta)$ N-m

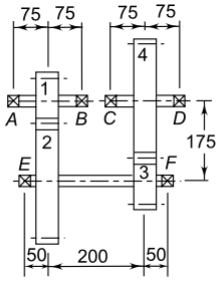
The resisting torque of the machine is given by

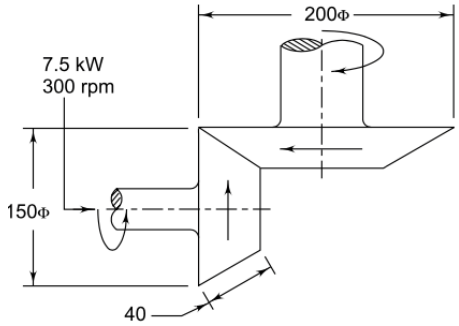
$To = 19000 + 3000 \sin \theta$ N-m

where θ is the crank angle. The engine is running at a mean speed of 300 rpm and the coefficient of speed fluctuations is limited to 0.03. Assume required data and state your assumptions.</td><td>PO1, PO2, PO4</td><td>C</td></tr>
<tr><td>10</td><td>The turning moment diagram of a multi- cylinder engine is drawn with a scale of (1mm=2°) on abscissa and (1mm= 1250 N-m) on ordinate. The intercepted areas between the torque developed by the engine and the mean resisting torque of the machine taken in order from one end are – 30, + 400, – 270, + 330, – 310, + 230, – 380, + 270, and – 240 mm2. The engine is running at a mean speed of 240 rpm and the coefficient of speed fluctuations is limited to 0.02. Design a rimmed flywheel made of grey cast iron FG 200. Assume the rim contribution to total moment of Inertia. The cross-section of the rim can be considered as a rectangle with width to thickness ratio of 2.5.</td><td>PO1, PO2, PO4</td><td>C</td></tr>
</table>

Question No	Questions	PO Attainment	BT
	UNIT 4 – DESIGN OF BEARINGS		
	PART-A (Two Marks Questions)		
1	What is radial bearing?	PO1	R
2	What is rolling-contact bearing?	PO1	R
3	Why are ball and roller bearings called 'antifriction' bearings?	PO2	R
4	Name the various types of roller bearings.	PO1	R
5	State any three advantages and two disadvantages of deep groove ball bearing.	PO1	R
6	Define static load carrying capacity of ball bearing.	PO1	R
7	Define rating life of bearing.	PO1	R
8	Define dynamic load carrying capacity of rolling-contact bearing.	PO1	R
9	What is L_{50} life?	PO1	R
10	What is the objective of pre-loading of rolling- contact bearings?	PO1, PO2	A
11	What is thick film lubrication?	PO1	R
12	What is a zero film bearing?	PO1	R
13	Why is hydrostatic bearing called 'externally pressurized' bearing?	PO2	AP
14	Write down Petroff's equation.	PO1	R
15	What is viscosity index?	PO1	R
16	What is full journal bearing and partial bearing?	PO1	R
17	What are the advantages and disadvantages of babbitt as bearing material?	PO1	A
18	What is hydrodynamic lubrication?	PO1	R
19	Why is hydrodynamic journal bearing called 'self acting' bearing?	PO1, PO2	AP
20	What is bearing characteristic number as applied to the journal bearing?	PO1, PO2	R, U
	PART–B(Ten Marks questions)		
1	Explain the principle of a self-aligning bearing. Mention it's applications. Derive the expression which shows the relationship between the static load on a Rolling contact bearing and the no.of balls present in the bearing.	PO1, PO2, PO3	A, E
2	Select a suitable ball bearing for when a single-row deep groove ball bearing is subjected to a radial force of 8 kN and a thrust force of 3 kN. The shaft rotates at 1200 rpm. The expected life L10h of the bearing is 20 000 h and the minimum acceptable diameter of the shaft is 75 mm.	PO1, PO2, PO4	C
3	A machine shaft, supported two identical taper roller bearings A and B, is shown in Fig. It is subjected to a radial force of 30 kN and a thrust force of 10 kN. The thrust is taken by Bearing A alone. The shaft rotates at 300 rpm. The machine is intermittently used and the expected life L10h of the bearings is 4000 h. The minimum acceptable diameter of the shaft, where the bearings are mounted, is 60 mm. Select suitable taper roller bearings for the shaft. 	PO1, PO2, PO4	C
4	How will measure viscosity in real world? Explain the process by giving example of the apparatus used. Also explain what is viscosity index and how is it measured using a neat sketch.	PO1, PO2, PO3	A, AP, E
5	How will you determine the co-efficient of friction in journal bearing? Also explain how transition from thin film lubrication to thick film lubrication is determined and explain the significance of the parameter used in this measurement briefly.	PO1, PO2, PO3	AP, E
6	Calculate (i) supply pressure; (ii) flow requirement in litres/min; (iii) power loss in pumping; and (iv) frictional power loss for a hydrostatic thrust bearing whose specifications are as follows: thrust load = 500 kN shaft speed = 720 rpm shaft diameter = 500 mm recess diameter = 300 mm film thickness = 0.15 mm viscosity of lubricant = 160 SUS specific gravity = 0.86	PO1, PO2, PO4	AP, E
7	"There is no exact solution to Reynold's equation for a journal bearing having a finite length". Then how is the performance of a journal bearing calculated? Explain neatly.	PO1, PO2, PO3	A, AP, E

8	Describe the selection parameters for bearing design briefly. How will you calculate the temperature rise and average temperature of lubricating oil when it subjected to a radial load?	PO1, PO2, PO3	R, A, AP
9	Design a full hydrodynamic journal bearing with the following specification for a machine tool application: journal diameter = 75 mm radial load = 10 kN journal speed = 1440 rpm minimum oil film thickness = 22.5microns inlet temperature = 40°C bearing material = babbitt Select a suitable lubricating oil for this application.	PO1, PO2, PO4	C
10	An oil ring bearing of a transmission shaft is shown in Fig below. There is no hydrodynamic action over the width of 4 mm of the oil ring. The total radial load acting on the journal is 20 kN and the journal rotates at 1450 rpm. The radial clearance and minimum film thickness are 20 to 5 microns respectively. Calculate (i) viscosity of the lubricant and (ii) required quantity of oil. 	PO1, PO2, PO4	E

Question No	Questions	PO Attainment	BT
	UNIT 5 – DESIGN OF SPUR, HELICAL, BEVEL & WORM GEARS		
	PART-A (Two Marks Questions)		
1	State any four advantages of gear drive over other types of drives.	PO1	R
2	In a gear speed reducer, why is the diameter of an output shaft greater than input shaft?	PO2	A
3	State two important reasons for adopting involute curve for gear tooth profile.	PO2	AP
4	What is the stub involute gear tooth system?	PO1	R
5	Why is the radial component of gear tooth force called 'separating' component?	PO1, PO2	A
6	What is pitting in a gear drive?	PO1	R
7	What are the advantages of planetary reduction gears as compared to ordinary gearboxes?	PO1	R
8	What is a crossed helical gear?	PO1	R
9	What is virtual or formative helical gear?	PO1	R
10	What is a herringbone helical gear?	PO1	R
11	Why are crossed helical gears not used for high power transmission?	PO1	A
12	What is the relationship between actual and virtual number of teeth and the helix angle?	PO1	R
13	Where do you use bevel gear?	PO1	R
14	What is miter gear?	PO1	R
15	What are the advantages of straight bevel gears over spiral bevel gears?	PO1	R
16	What is hypoid gear? Why is it used in automobiles?	PO1	R
17	Where do you use worm gear drive?	PO1	R
18	What kind of contact occurs between worm and worm wheel? How does it differ from other types of gears?	PO1, PO2	R, AP
19	What are single-enveloping and double- enveloping worm gear drives? Where do you use them?	PO1	R
20	Why is the efficiency of worm gear drive low?	PO1	A
	PART–B(Ten Marks questions)		
1	The layout of a two-stage gear box is shown in Fig. below. The number of teeth on the gears are as follows: $z_1 = 20\ z_2 = 50\ z_3 = 20\ z_4 = 50$ Pinion 1 rotates at 1440 rpm in the anti-clockwise direction when observed from the left side of the setup and transmits 10 kW of power to the gear train. The pressure angle is 20°. Draw a free-body diagram of the gear tooth forces and determine the reactions at bearings E and F. 	PO1, PO2, PO4	C
2	What do you understand when you hear the term "beam strength of tooth"? What is its significance? Explain what happens to the effective load on a gear tooth when the torque supplied to the driving shaft fluctuates.	PO1, PO3	A, AP, E
3	When we say "wear strength of a tooth" what does it specify? How is it different from beam strength of a tooth? Explain when beam strength or wear strength is used as a criterion for design. Also, can you calculate the module of gear using either beam strength or wear strength of tooth? If so, how?	PO1, PO2, PO3	U, A, AP
4	A pair of spur gears with 20° full-depth involute teeth consists of a 20 teeth pinion meshing with a 41 teeth gear. The module is 3 mm while the face width is 40 mm. The material for pinion as well as gear is steel with an ultimate tensile strength of 600 N/mm^2. The gears are heat- treated to a surface hardness of 400 BHN. The pinion rotates at 1450 rpm and the service factor for the application is 1.75. Assume that velocity factor accounts for the dynamic load and the factor of safety is 1.5. Determine the rated power that the gears can transmit.	PO1, PO2, PO4	C
5	What do you understand by the term "Formative Spur Gear"? Explain briefly why, where and how is it used in the design of a Helical gear. Also mention the different tooth proportions required to complete the design of a helical gear.	PO1, PO2, PO3	U, A, AP
6	a) How is beam strength and wear strength of a helical gear different from that of a spur gear. b) A pair of parallel helical gears consists of 24 teeth pinion rotating at 5000 rpm and supplying 2.5 kW power to a gear. The speed reduction is 4 : 1. The normal pressure angle and helix angle are	PO1, PO2, PO3, PO4	R, E

	20° and 23° respectively. Both gears are made of hardened steel (S_{ut} = 750 N/mm^2). The service factor and the factor of safety are 1.5 and 2 respectively. The gears are finished to meet the accuracy of Grade 4. (i) In the initial stages of gear design, assume that the velocity factor accounts for the dynamic load and that the face width is ten times the normal module. Assuming the pitch line velocity to be 10 m/s, estimate the normal module. (ii) Select the first preference value of the normal module and calculate the main dimensions of the gears. (iii) Determine the dynamic load using Buckingham's equation and find out the effective load for the above dimensions. What is the correct factor of safety for bending? (iv) Specify surface hardness for the gears, assuming a factor of safety of 2 for wear consideration.		
7	Perform an analysis of force components acting on a bevel gear and derive the expressions for all the parameters using free body diagrams. A pair of bevel gears transmitting 7.5 kW at 300 rpm is shown in Fig below. The pressure angle is 20°. Determine the components of the resultant gear tooth force and draw a free-body diagram of forces acting on the pinion and the gear.  	PO1, PO2, PO4	A, E
8	A straight bevel gear setup consisting of a 24-teeth pinion and a 48 teeth gear has a module at the outside diameter of 6 mm, while the face width is 50 mm. The gears are made of grey cast iron FG 220 (S_{ut} = 220 N/mm^2) and their pressure angle is 20°. The teeth are generated and assume that velocity factor accounts for the dynamic load. The pinion rotates at 300 rpm and the service factor is 1.5. Calculate 1. the beam strength of the tooth; 2. the static load that the gears can transmit with a factor of safety of 2 for bending consideration; and 3. the rated power that the gears can transmit.	PO1, PO2, PO4	A,E
9	Draw a free body diagram of Worm gear setup depicting the force components on worm wheel and worm. Explain how much of a significance friction has on the efficiency of a worm gear drive	PO1, PO2, PO3	A, AP
10	A worm gear box with an effective surface area of 1.5 m^2 is operating in still air with a heat transfer coefficient of 15 W/m^2°C. The temperature rise of the lubricating oil above the atmospheric temperature is limited to 50°C. The worm gears are designated as, 1/30/10/8 The worm shaft is rotating at 1440 rpm and the normal pressure angle is 20°. Calculate the power transmitting capacity based on the thermal considerations.	PO1, PO2, PO4	C

Bloom's Taxonomy

Code	Description
R	Remember
U	Understand
A	Analyse
AP	Apply
E	Evaluate
C	Create

PROGRAM OUTCOMES (PO's)

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety and the cultural, societal and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select and apply appropriate techniques, resources and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual and as a member or leader in diverse teams and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

DESIGN OF TRANSMISSION SYSTEMS

Question Bank

III B.TECH- II SEMESTER Regulation: R18

ACADEMIC YEAR: 2020-21

Faculty In charge

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SITAMS