



INSTITUTE OF AERONAUTICAL ENGINEERING

(AUTONOMOUS)

Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING TUTORIAL QUESTION BANK 2017 - 2018

Course Name	:	DESIGN OF MACHINE MEMBERS-II
Course Code	:	A60329
Class	:	III B. Tech II Semester
Branch	:	Mechanical Engineering
Year	:	2017-18
Course Coordinator	:	Dr. G. V. R.Seshagiri Rao Professor
Course Faculty	:	Dr. G. V. R. Seshagiri Rao, Professor, Mrs. Krishnaja, Assistant Professor.

COURSE OVERVIEW:

The design of machine members-II focus mainly on design of power transmitting elements like gears, connecting rod, crankpin, crankshafts, pistons, cylinders, bearings, belts, ropes, chain's, pulleys, Power screws and nuts. Design basis is strength and stiffness of the parts and selection of material for manufacture of machine elements.

S. No	Question	Blooms Taxonomy Level	Program Outcome
UNIT – I			
PART – A (SHORT ANSWER QUESTIONS)			
1	What is meant by hydrodynamic lubrication?	Understand	1
2	Explain wedge film and squeeze film journal bearings.	Understand	1
3	Explain Bearing characteristic number for journal bearings.	Understand	1
4	What are the commonly used materials for sliding contact bearings?	Remember	1
5	Explain the various types of lubrications.	Understand	1
6	List the important physical characteristics of a good bearing material.	Remember	1
7	Write short note on classifications and different types of antifriction bearings.	Understand	2
8	Define Basic static load rating in rolling contact bearings.	Remember	2
9	Define Basic dynamic load rating in rolling contact bearings.	Remember	2
10	Write some guide lines for selecting a proper type of bearing.	Remember	2
11	Explain Bearing modulus for journal bearings.	Understand	2
12	Define Static equivalent load rating in rolling contact bearings.	Remember	2

13	Define Dynamic equivalent load rating in rolling contact bearings	Remember	2
14	What is bearing?	Remember	2
15	Define rating life	Remember	2
16	What is square bearing?	Remember	2
17	What are the advantages and disadvantages of sliding contact bearings over rolling contact bearings?	Remember	2
18	Define loading ratio?	Remember	2
19	Discuss reliability of a Bearing	Remember	2
20	Write a short note on lubrication of ball and roller bearings.	Understand	2
PART – B (LONG ANSWER QUESTIONS)			
1	The load on the journal bearing is 150 kN due to turbine shaft of 300 mm diameter running at 1800 r.p.m. Determine the following : 1. Length of the bearing if the allowable bearing pressure is 1.6 N/mm ² , and Amount of heat to be removed by the lubricant per minute if the bearing temperature is 600°C and viscosity of the oil at 600°C is 0.02 kg/ms and the bearing clearance is 0.25 mm.	Understand	3
2	A 80 mm long journal bearing supports a load of 2800 N on a 50 mm diameter shaft. The bearing has a radial clearance 0.05 mm and the viscosity of the oil is 0.021 kg/ms at the operating temperature. If the bearing is capable of dissipating 80 J/s, determine the maximum safe speed.	Understand	3
3	A journal bearing 60 mm is diameter and 90 mm long runs at 450 r.p.m. The oil used for hydrodynamic lubrication has absolute viscosity of 0.06 kg/m-s. If the diametral clearance is 0.1 mm, find the safe load on the bearing.	Understand	3
4	A full journal bearing of 50 mm diameter & 100 mm long has a bearing pressure of 1.4 N/mm ² . The speed of the journal is 900 rpm & 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 0.11 kg/m-s. The room temperature 35°C. Find the amount of artificial cooling required.	Understand	3
5	A journal bearing 150 mm diameter & 300 mm long carries a radial load of 9 kN at 1200 rpm. The power lost in friction is 6 kW. Viscosity of oil at room temperature is 0.018 Pa. Find the diametral clearance.	Understand	3
6	Design a suitable journal bearing for a centrifugal pump from the following available data: Load on the bearing = 13.5 kN; Diameter of the journal = 80 mm; Speed = 1440 r.p.m.; Bearing characteristic number at the working temperature (75°C) = 30; Permissible bearing pressure intensity = 0.7 N/mm ² to 1.4 N/mm ² ; Average atmospheric temperature = 30°C. Calculate the cooling requirements. If any?	Understand	3
7	Select a single row deep groove ball bearing for a radial load of 4000 N and an axial load of 5000 N, operating at a speed of 1600 r.p.m. for an average life of 5 years at 10 hours per day. Assume uniform and steady load.	Understand	3
8	The rolling contact ball bearings are to be selected to support the overhung countershaft. The shaft speed is 720 r.p.m. The bearings are to have 99% reliability corresponding to a life of 24000 hours. The bearing is subjected to an equivalent radial load of 1 kN. Consider life adjustment factors for operating condition and material as 0.9 and 0.85 respectively. Find the basic dynamic load rating of the bearing from manufacturer's catalogue, specific at 90% reliability.	Understand	3
9	Design self-aligning ball bearings for a radial load of 7000 N and a thrust load of 2100 N. the desired life of the bearing is 160 millions of revolutions at 300 r.p.m. Assume uniform and steady load.	Understand	3

10	A ball bearing subjected to a radial load of 5000N is expected to have a satisfactory life of 8000 hours at 1450r.p.m with a reliability of 99%.Calculate the dynamic load capacity of the bearing.	Understand	3
11	A 150mm diameter shaft supporting a load of 10KN has a speed of 1500rpm.The shaft run in whose bearing length is 1.5 times the shaft diameter. If the diametric clearance of bearing is 0.15mm and the absolute viscosity of the oil at the operating temperature is 0.011 Kg/m-s. Find the power wasted in friction.	Understand	3
12	A full journal bearing of 50mm diameter and 100mm long has a bearing pressure of 1.4N/mm ² • The speed of the journal is 900rpm and the ratio of journal diameter to the diametric 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 350C.Find, (1) The amount of artificial cooling required. (2)The mass of lubricating oil required, if the difference between the outlet and inlet temperature of the oil is 10°C. Take specific heat of oil as 1850J/Kg/0C.	Understand	3
13	Design a journal bearing for a centrifugal pump from the following data: Load on the journal=20000N, Speed of the journal=900rpm, Type of oil is SAE 40, for which the absolute viscosity at 55°C=0.017kg/m-s, Ambient temperature of oil = 15.50C, Maximum bearing pressure for the pump=1.5N/mm ² Calculate also mass of the lubricating oil required for artificial cooling, If the rise of temperature, if the rise of temperature of oil be limited to 10 ⁰ c heat dissipation coefficient=1232W/m ² / °C.	Understand	3
14	Design a journal bearing for a centrifugal pump with the following data: Diameter of the journal = 150mm Load on bearing = 40KN Speed of journal = 900rpm	Understand	3
15	A journal bearing 150mm in dia and 225mm long is supporting a load of 9KN at 1000rpm.If the radial clearance is 0.075mm and the bearing dissipates 1.5KW in friction. What is the viscosity of the oil at the operating temperature?		
16	A full journal bearing has the following specifications: Journal dia : 60mm Bearing length 75mm Radial load on the bearing 25KN Radial clearance 0.06mm Speed of rotation 1450 rpm Determine mean viscosity of lubricating oil in the film if the minimum film under operating conditions is 0.0125mm.	Understand	3
17	A steam turbine shaft 200mm diameter turns at 1800 rpm and is supported in a journal bearing on which the total load is 90KN Room temp is 30°C; The bearing temp is 60°C, Allowable bearing pressure is 1.5MPa. Determine the length of the bearing and amount of heat to be removed by the lubricant per minute. Viscosity of oil at 60°C is 0.021 N/m	Understand	3
18	A journal bearing 60 mm is diameter and 80 mm long runs at 450 r.p.m. The oil used for hydrodynamic lubrication has absolute viscosity of 0.06 kg/m-s. if the diametral clearance is 0.1 mm, find the safe load on the bearing.	Understand	3
19	A ball bearing subjected to a radial load of 6000N is expected to have a satisfactory life of 8000 hours at 2450r.p.m with a reliability of 97%.Calculate the dynamic load capacity of the bearing	Understand	3
20	A 306 radial ball bearing with inner ring rotation as 8s work cycle as Follows Radial force 3KN Axial load 2KN Speed 1200rpm Under steady load conditions the basic dynamic load capacity of the bearing is 24.25KN. Determine the expected average life of this bearing. Take X=0.56 and Y=1.43	Understand	3

	PART – C (ANALYTICAL QUESTIONS)		
1	Design a journal bearing for a centrifugal pump with the following data: Diameter of the journal = 150mm Load on bearing = 40KN Speed of journal = 900rpm	Understand	3
2	Design a journal bearing for a centrifugal pump from the following data: Load on the journal=20000N, Speed of the journal=900rpm, Type of oil is SAE10, for which the absolute viscosity at 55°C=0.017kg/m-s, Ambient temperature of oil = 15.50C, Maximum bearing pressure for the pump=1.5N/mm ² . Calculate also mass of the lubricating oil required for artificial cooling, If the rise of temperature, if the rise of temperature of oil be limited to 10°C heat dissipation coefficient=1232W/m ² /°C	Understand	3
3	A full journal bearing of 50mm diameter and 100mm long has a bearing pressure of 1.4N/mm ² . The speed of the journal is 900rpm and the ratio of journal diameter to the diametric 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 350C. Find, (1) The amount of artificial cooling required. (2) The mass of lubricating oil required, if the difference between the outlet and inlet temperature of the oil is 10°C. Take specific heat of oil as 1850J/Kg/°C.	Understand	3
4	A 150mm diameter shaft supporting a load of 10KN has a speed of 1500rpm. The shaft run in whose bearing length is 1.5 times the shaft diameter. If the diametric clearance of bearing is 0.15mm and the absolute viscosity of the oil at the operating temperature is 0.011 Kg/m-s. Find the power wasted in friction	Understand	3
5	Design a journal bearing to withstand a load of 5886 N. Speed of the journal is 1100 rpm. The journal is made of hardened steel and bearing is made of babbit. Operating Temperature is 70°C and ambient temperature is 30°C. Check the design for equilibrium and also determine the power loss at the bearing. The lubricant used of grade. SAE 40 lid = 1.	Understand	3
6	The following data are given for a full journal bearing: Radial load: 25 KN, L/d ratio: 1:1 Unit bearing pressure: 2.5 MPa. Viscosity of the lubricant: 20 Cp. Class of fit: H7 e7. Calculate: i) Dimensions of the bearing ii) Minimum oil film thickness. iii) Requirement of oil flow. Assume that the process to clearance is centered	Understand	3
7	A 75 mm journal bearing of diameters 75 mm supports a load of 15 KN. The ratio of journal diameter to the diametric clearance is 1000 and the viscosity of the oil is 25×10^{-3} PaS. The heat generated in the bearing is 442 watts. Determine the maximum speed of the journal using McKee's equation	Understand	3
8	SAE 20 oil is used to lubricate a hydrodynamic journal bearing of diameter 75mm and length 75 mm. The journal rotates at 1,200 rpm, the diametric clearance is 0.075 mm, the operating temperature of the oil is 53°C, and the oil enters at 40°C. Calculate power loss due to friction	Understand	3

9.	<p>The following data are given for a 3600 hydro - dynamic bearing: Bearing diameter: 50.02 mm Journal diameter: 49.93 mm Bearing length: 50 mm Journal speed: 1440 <i>r/min</i> Radial load = 8kN Viscosity of lubricant: 12 cp. The bearing is machined on a lathe from bronze casting, while the steel journal is hardened and ground. The surface roughness values for turning and grinding are 0.8 and 0.4 microns respectively. For thick film lubrication the minimum film Thickness should be five times the sum of surface roughness values for the journal and the bearing. Calculate.</p> <p>i) The permissible minimum film thickness. ii) The actual film thickness under the operating conditions. iii) Power loss in friction. iii) Flow requirement</p>	Understand	3
10	<p>A journal bearing is to be designed for a centrifugal pump for the following data: Load on the journal = 12 KN; Diameter of the journal = 75 mm; Speed = 1440 rpm; Atmospheric temperature of the oil = 16°C; Operating temperature of the oil = 60°C; Absolute viscosity of oil at 60°C = 0.023 kg/m-s. Give a systematic design of the bearing.</p>	Understand	3

UNIT – II

	PART – A (SHORT ANSWER QUESTIONS)		
1	Discuss the design of piston for an internal combustion engine	Understand	6
2	Write a short note on piston rings.	Understand	6
3	Explain the various stresses induced in the connecting rod	Understand	6
4	What is the function of a connecting rod of an internal combustion engine?	Remember	6
5	Discuss about force acting on the connecting rod.	Understand	6
6	Under what force, the big and end bolts and caps are designed?	Understand	6
7	At what angle of the crank the twisting moment is maximum in the crank shaft?	Understand	2
8	What are the methods and materials used in the manufacture of piston	Remember	2
9	What are the methods and materials used in the manufacture of crankshafts?	Remember	2
10	State the function of the ribs for an IC engine piston	Remember	2
11	State the function of the Piston rings for an IC engine piston	Remember	2
12	State the function of the piston skirt for an IC engine piston	Remember	2
13	State the function of the piston pin for an IC engine piston	Remember	2
14	What are the methods and materials used in the manufacture of connecting rod	Remember	2
15	Discuss on what considerations piston head is designed.	Understand	2
16	Writ a shot not on required characteristics of piston	Understand	2
17	What are various types of crank shafts?	Remember	2
18	Writ a shot notes on whipping stress in connecting rod.	Remember	2
19	Under what force piston pin and crank pin are designed.	Understand	2
20	Why I section of connecting rod is used.	Understand	2

PART – B (LONG ANSWER QUESTIONS)

S. No	Question	Blooms Taxonomy Level	Program Outcome
1	Design a plain carbon steel centre crankshaft for a single acting four stroke single cylinder engine for the following data: Bore = 400 mm, Stroke = 600 mm; Engine speed = 200 r.p.m; Mean effective pressure = 0.5 N/mm^2 ; Maximum combustion pressure = 2.5 N/mm^2 ; Weight of flywheel used as a pulley = 50kN; Total belt pull = 6.5kN. When the crank has turned through 35° from the top dead centre, the pressure on the piston is 1 N/mm^2 and the torque on the crank is maximum. The ratio of the connecting rod length to the crank radius is 5. Assume any other data required for the design.	Understand	2
2	Design a connecting rod for an I.C. engine running at 1800 r.p.m and developing a maximum pressure of 3.15 N/mm^2 . The diameter of the piston is 100 mm; mass of the reciprocating parts per cylinder 2.25kg; length of connecting rod 380 mm; stroke of piston 190 mm 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 and the corresponding bearing pressures as 10 N/mm^2 and 15 N/mm^2 . The density of material of the rod may be taken as 8000 kg/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.. Use Rankine formula for which the numerator constant may be taken as 320 N/mm^2 and the denominator 1/7500.	Understand	2
3	Design a cast iron piston for a single acting four stroke engine for the following data: Cylinder bore = 100mm; Stroke = 125mm; Maximum gas pressure = 5 N/mm^2 ; Indicated mean effective pressure = 0.75 N/mm^2 ; Mechanical efficiency = 80%; Fuel consumption = 0.15kg per brake power per hour; Higher calorific value of fuel = $42 \times 10^3 \text{ kJ/kg}$; Speed = 2000r.p.m. Any other data required for the design may be assumed.	Understand	2
4	Design a side or overhung crankshaft for a 250x300mm gas engine. The weight of the flywheel is 30KN and the explosion temperature is 2.1 N/mm^2 . The gas pressure at the maximum torque is 0.9 N/mm^2 , when the crank angle is 35° from I.D.C. the connecting rod is 4.5 times the crank radius.	Understand	2
5	The following particulars refer to a 4 stroke diesel engine given: Piston diameter = 150mm Stroke length = 180mm Length of the connecting rod = 4 times of length of crank Rated rpm of the engine = 1500; Compression ratio = 6:1 Mass of reciprocating parts per cylinder = 2.25kg ;Speed = 1200rpm Maximum explosion pressure = 5Mpa Factor of safety = 6 Yield strength in compression 350Mpa. Determine 1. Cross section of I-section connecting rod assuming standard Proportions. 2. Sizes of gudgeon pin and crank pin considering bearing pressures of 15mpa and 10 MPa respectively. 3. Size of crank pin end bolts if the allowable stress not to exceed 40Mpa.	Understand	2
6	Design a cast iron piston for a single acting four stroke engine for the following data: Cylinder bore = 120mm; Stroke = 150mm; Maximum gas pressure = 5 N/mm^2 ; Indicated mean effective pressure = 0.7 N/mm^2 ; Mechanical efficiency = 80%; Fuel consumption = 0.25kg per brake power per hour; Higher calorific value of fuel = $42 \times 10^3 \text{ kJ/kg}$; Speed = 2400r.p.m. Any other data required for the design may be assumed.	Understand	2

7	<p>Design a centre crank shaft when the crank is at the dead centre for a single acting four stroke single cylinder engine for the following given data: Assume any other missing data. Piston diameter = 400mm Stroke = 600mm Speed = 200 rev/min I.M.E.0.5Mpa Maximum combustion Pressure = 2.5Mpa Gas pressure at the maximum torque = 1 MPa at 350 crank angle Ratio of length of connecting rod to crank radius = 5 Weight of flywheel used as a pulley = 5.0KN Total belt pull = 6.5N. a. Design of the crank pin b. Design of the left hand crank web.</p>	Understand	2
8	<p>Design high speed petrol engine connecting rod, given: Piston diameter = 100mm Stroke length = 138mm Length of the connecting rod=310mm Rated rpm of the engine =1500 Compression ratio = 4:1 Weight of reciprocating parts per cylinder = 1.8kg Speed = 2500 Maximum explosion pressure = 2.45Mpa Bearing pressure for big end = 7MPa Bearing pressure for small end = 14MPa Connecting rod should be of I-section and be made of forged steel, the proportions being depth $h=5t$, width $=4t$, where t is the flange and web thickness. Determine: a. Dimensions of the crank pin & piston pin b. Size of the bolts for securing the big end cap.</p>	Understand	2
9	<p>Design a piston for a four stroke diesel engine consuming 0.3kg of fuel per kW of power per hour and produces a brake mean effective pressure of the 0.7N/mm^2. The maximum gas pressure inside the cylinder is 5N/mm^2 at a speed of 3500 r.p.m. The cylinder diameter is required to be 300mm with stroke 1.5 times the diameter. The piston may have 4 compression rings and an oil ring. The following data can be used for design. Higher calorific value of fuel $=46 \times 10^3 \text{ kJ/kg}$; Temperature at the piston centre = 700K; Temperature at the piston edge=475K; Heat conductivity factor=46.6 W/m/K; Heat conducted through top=5% of heat produced; Permissible tensile strength for the material of piston = 27N/mm^2; Pressure between rings and piston = 0.04N/mm^2; Permissible tensile stress in rings = 80N/mm^2; Permissible Pressure on piston barrel = 0.4N/mm^2; Permissible pressure on piston pin=15N/mm^2; Permissible stress in piston pin=85N/mm^2.</p>	Understand	2
10	<p>A Connecting rod is required to be designed for a high speed, four stroke I.C. engine. The following data are available. Diameter of piston = 88mm; Mass of reciprocating parts=1.6kg; Length of connecting rod (centre to centre) =300 mm; Stroke = 125 mm; R.P.M=2200 (when developing 50kW); Possible over speed=3000r.p.m; Compression ratio = 6.8:1 (approximately); Probable maximum explosion pressure (assumed shortly after dead centre, say at about 3°) = 3.5N/mm^2.</p>	Understand	2
11	<p>Design a side or overhung crankshaft for a 500x600mm gas engine. The weight of the flywheel is 80KN and the explosion temperature is 2.5N/mm^2. The gas pressure at the maximum torque is 0.9 N/mm^2, when the crank angle is 30° from I.D.C. the connecting rod is 4.5 times the crank radius.</p>	Understand	2
12	<p>Design a plain carbon steel centre crankshaft for a single acting four stroke single cylinder engine for the following data: Bore = 250 mm, Stroke = 400</p>		2

	mm, Maximum combustion pressure = 2.5 N/mm^2 ; Weight of flywheel used as a pulley = 16kN; Total belt pull = 3N. When the crank has turned through 30° from the top dead centre, the pressure on the piston is 1 N/mm^2 and the torque on the crank is maximum. The connecting rod length 950mm.	Understand	
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S. No	Question	Blooms Taxonomy Level	Program Outcome
13	Design a cast iron piston for a single acting four stroke engine for the following data: Cylinder bore = 100mm; Stroke = 120mm; Maximum gas pressure = 4 N/mm^2 ; Indicated mean effective pressure = 0.75 N/mm^2 ; Mechanical efficiency = 80%; Fuel consumption = 0.15kg per brake power per hour; Higher calorific value of fuel = $42 \times 10^3 \text{ kJ/kg}$; Speed = 2000r.p.m. Any other data required for the design may be assumed.	Understand	2
14	The specifications of high speed petrol engine connecting rod are given as below: Piston diameter = 100mm Stroke length = 125mm Length of the connecting rod = 300mm Rated rpm of the engine = 1500 Compression ratio = 6:1 Mass of reciprocating parts per cylinder = 2.25kg Speed = 1500rpm Maximum explosion pressure = 3.5Mpa Bearing pressure for big end = 7MPa Bearing pressure for small end = 14MPa Factor of safety = 7 Density = 8000 kg/m^3 Yield strength in compression 330Mpa. Connecting rod should be of I-section and be made of forged steel, the proportions being depth $h = 5t$, width $= 4t$, where t is the flange and web thickness. Determine: a. Dimensions of the crank pin & piston pin b. Size of the bolts for securing the big end cap.	Understand	2
15	Design a side or overhung crankshaft for a 500x600mm gas engine. The weight of the flywheel is 80KN and the explosion temperature is 2.5 N/mm^2 . The gas pressure at the maximum torque is 0.9 N/mm^2 , when the crank angle is 35° from I.D.C. the connecting rod is 4.5 times the crank radius.	Understand	2
16	Design a cast iron piston for a single acting four stroke engine for the following data: Cylinder bore = 120mm; Stroke = 150mm; Maximum gas pressure = 4.5 N/mm^2 ; Indicated mean effective pressure = 0.7 N/mm^2 ; Mechanical efficiency = 80%; Fuel consumption = 0.25kg per brake power per hour; Higher calorific value of fuel = $42 \times 10^3 \text{ kJ/kg}$; Speed = 1200r.p.m. Any other data required for the design may be assumed.	Understand	2
17	Design a cast iron piston for a single acting four stroke engine for the following data: Cylinder bore = 120mm; Stroke = 180mm; Maximum gas pressure = 5 N/mm^2 ; Indicated mean effective pressure = 0.75 N/mm^2 ; Mechanical efficiency = 80%; Fuel consumption = 0.35kg per brake power per hour; Higher calorific value of fuel = $42 \times 10^3 \text{ kJ/kg}$; Speed = 2400r.p.m. Any other data required for the design may be assumed.	Understand	2

18	<p>Design a connecting rod with following particulars refer to a 4 stroke diesel engine given:</p> <p>Piston diameter = 150mm; Stroke length = 180mm</p> <p>Length of the connecting rod= 4 times of length of crank</p> <p>Rated rpm of the engine =1500; Compression ratio = 6:1</p> <p>Mass of reciprocating parts per cylinder = 2.25kg</p> <p>Speed = 1200rpm; Maximum explosion pressure = 5Mpa ;Factor of safety=7</p> <p>Yield strength in compression 350Mpa.</p> <p>Bearing pressure for big end = 7MPa</p> <p>Bearing pressure for small end = 14MPa.</p>	Understand	2
19	<p>Design high speed petrol engine connecting rod, given:</p> <p>Piston diameter = 100mm</p> <p>Stroke length = 125mm</p> <p>Length of the connecting rod=300mm</p> <p>Rated rpm of the engine =1500</p> <p>Compression ratio = 6:1</p> <p>Mass of reciprocating parts per cylinder = 2.25kg</p> <p>Speed = 1500rpm</p> <p>Maximum explosion pressure = 3.5Mpa</p> <p>Bearing pressure for big end = 7MPa</p> <p>Bearing pressure for small end = 14MPa</p> <p>Factor of safety=7</p> <p>Density= 8000kg/m³</p> <p>Yield strength in compression 330Mpa.</p> <p>Connecting rod should be of I-section and be made of forged steel, the proportions being depth h=5t, width =4t, where is the flange and web thickness.</p>	Understand	2
20	<p>Determine the dimensions of I-Section connecting rod diesel engine with the given particulars:</p> <p>Piston diameter = 120mm</p> <p>Stroke length = 140mm</p> <p>Length of the connecting rod= 420mm</p> <p>Rated rpm of the engine =1500</p> <p>Mass of reciprocating parts per cylinder = 2.5kg</p> <p>Speed = 1500rpm</p> <p>Maximum explosion pressure = 4.5Mpa</p> <p>Factor of safety=7</p> <p>Yield strength in compression 330Mpa. Determine the whipping stress.</p>	Understand	2

PART – C (ANALYTICAL QUESTIONS)

1	Design a trunk piston for an IC engine. The piston is made of cast iron with an allowable stress of 38.5 MPa. The bore of the cylinder is 200 mm and the maximum explosion pressure is 0.4 MPa. The permissible bending stress of the gudgeon pin is 100 MPa. The bearing pressure in the gudgeon pin bearing of the connection rod is to be taken as 200 MPa	Understand	2
2	Explain the considerations given in the design of pistons for IC engines.	Understand	2
3	Design a side or overhung crankshaft for a 500x600mm gas engine. The weight of the flywheel is 85KN and the explosion pressure is 2.5N/mm ² . The gas pressure at the maximum torque is 0.95 N/mm ² , when the crank angle is 30° from I.D.C. the connecting rod is 4.5 times the crank radius.	Understand	2
4	A Connecting rod is required to be designed for a high speed, four stroke I.C. engine. The following data are available. Diameter of piston = 75mm; Mass of reciprocating parts=1.6kg; Length of connecting rod (centre to centre) =350 mm; Stroke = 125 mm; R.P.M=2200 (when developing 50kW); Possible over speed=3000r.p.m; Compression ratio = 6.8:1 (approximately); Probable maximum explosion pressure (assumed shortly after dead centre, say at about 30°) = 4.5N/mm ² .	Understand	2

5	<p>Determine the dimensions of I-Section connecting rod diesel engine with the given particulars: Piston diameter = 110mm Stroke length = 140mm Length of the connecting rod = 420mm Rated rpm of the engine = 1600 Mass of reciprocating parts per cylinder = 2.5kg Speed = 1500rpm Maximum explosion pressure = 4.5Mpa Factor of safety = 7 Yield strength in compression 330Mpa. Determine the whipping stress.</p>	Understand	2
6	<p>Design high speed petrol engine connecting rod, given: Piston diameter = 100mm Stroke length = 130mm Length of the connecting rod = 300mm Rated rpm of the engine = 1500 Compression ratio = 6:1 Mass of reciprocating parts per cylinder = 2.25kg Speed = 1500rpm Maximum explosion pressure = 3.5Mpa Bearing pressure for big end = 7MPa Bearing pressure for small end = 14MPa Factor of safety = 7 Density = 8000kg/m^3 Yield strength in compression 330Mpa. Connecting rod should be of I-section and be made of forged steel, the proportions being depth $h=5t$, width $=4t$, where t is the flange and web thickness.</p>	Understand	2
7	<p>Design a cast iron piston for a single acting four stroke engine for the following data: Cylinder bore = 90mm; Stroke = 120mm; Maximum gas pressure = 4N/mm^2; Indicated mean effective pressure = 0.75 N/mm^2; Mechanical efficiency = 85%; Fuel consumption = 0.15kg per brake power per hour; Higher calorific value of fuel = $42 \times 10^3\text{ kJ/kg}$; Speed = 2100r.p.m. Any other data required for the design may be assumed.</p>	Understand	2
8	<p>The specifications of high speed petrol engine connecting rod are given as below: Piston diameter = 100mm Stroke length = 135mm Length of the connecting rod = 370mm Rated rpm of the engine = 1500 Compression ratio = 6:1 Mass of reciprocating parts per cylinder = 2.25kg Speed = 1500rpm Maximum explosion pressure = 3.5Mpa Bearing pressure for big end = 7MPa Bearing pressure for small end = 14MPa Factor of safety = 7 Density = 8000kg/m^3 Yield strength in compression 330Mpa. Connecting rod should be of I-section and be made of forged steel, the proportions being depth $h=5t$, width $=4t$, where t is the flange and web thickness. Determine: a. Dimensions of the crank pin & piston pin b. Size of the bolts for securing the big end cap.</p>	Understand	2

9	Design a plain carbon steel centre crankshaft for a single acting four stroke single cylinder engine for the following data: Bore = 260 mm, Stroke = 400 mm, Maximum combustion pressure = 2.5 N/mm^2 ; Weight of flywheel used as a pulley = 15kN; Total belt pull = 3N. When the crank has turned through 30° from the top dead centre, the pressure on the piston is 1 N/mm^2 and the torque on the crank is maximum. The connecting rod length 950mm. Assume any other data required for the design.	Understand	2
10	Design a connecting rod with following particulars refer to a 4 stroke diesel engine given: Piston diameter = 150mm Stroke length = 200mm Length of the connecting rod = 4 times of length of crank Rated rpm of the engine = 1200 Compression ratio = 6:1 Mass of reciprocating parts per cylinder = 2.25kg Speed = 1200rpm Maximum explosion pressure = 5Mpa Factor of safety = 7 Yield strength in compression 350Mpa. Bearing pressure for big end = 7Mpa Bearing pressure for small end = 14MPa.	Understand	2

UNIT – III

PART – A (SHORT ANSWER QUESTIONS)

1	Discuss about the various types of belt drives with neat sketches?	Understand	4
2	On what factors does the power transmitted by a belts depends?	Understand	4
3	How do you classify the chain drives?	Understand	4
4	Name the type of stresses induced in the wire?	Remember	4
5	Write in brief on Hoisting and hauling chains, Conveyor chains, and Silent Chains	Understand	4
6	Under what circumstances a fibre rope and a wire rope is used? What are the advantages of a wire rope over fibre rope?	Understand	4
7	State the advantages and disadvantages of the chain drive over belt and rope Drive	Remember	4
8	What are the advantages and disadvantages of V-belt drive over flat belt drive?	Remember	4
9	Discuss the uses and construction of wire ropes. How is wire rope ends fastened?	Remember	4
10	Derive the relation for the ratio of driving tensions of a V-belt.	Understand	4
11	Why the face of a pulley is crowned?	Understand	4
12	Derive the condition for transmission of maximum power in belt drives.	Understand	4
13	Discuss different types of pulleys used for belt drives	Understand	4
14	When a split pulley is used and how it is tightened on a shaft?	Understand	4
15	Derive the relation for the ratio of driving tensions of a Flat belt.	Understand	4
16	Explain about fast and loose pulley.	Understand	4
17	Discuss the procedure used for designing a cast iron pulley	Understand	4
18	What are simplex, duplex and triplex chains?	Remember	4
19	Write the design procedure for a chain drive	Understand	4
20	Discuss about classification of chains	Understand	4

PART – B (LONG ANSWER QUESTIONS)

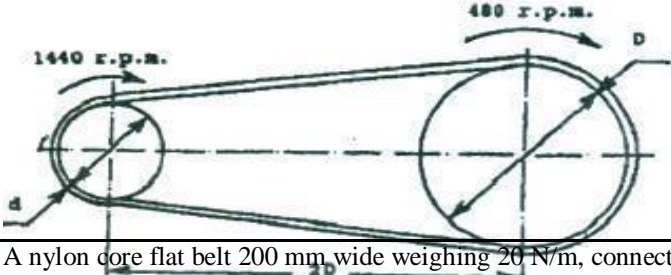
1	A belt, 100 x 10mm is transmitting power at 15m/s. the angle of contact on the driver (smaller) pulley is 156° , if the permissible stress for the belt material is 2 N/mm^2 ; determine the power that can be transmitted at this speed. Take the density of leather as 1000 kg/m^3 and coefficient of friction as 0.25. Calculate the maximum power that can be transmitted	Understand	4
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2	Design a belt pulley for transmitting 10kW at 180 rpm. The velocity of the belt is not to exceed 10m/s and the maximum tension is not to exceed 15N/mm width. The tension on the slack side is one half that on the tight side. Determine all the principle dimensions of the pulley.	Understand	4
3	A bucket elevator is to be driven by a gear motor and roller chain drive gear motor=5kW; Speed of gear motor=100 rev/min; Load=10KN, Centre distance = 1220 mm. Elevator will operate 16-24 hrs per day. Select the chain.	Understand	4
4	A roller chain operating under steady load conditions transmits 4kW from a shaft rotating at 600rev/min to one operating at 750rev/min. i. Determine the chain required using at least 15 teeth in sprockets. ii. Determine the sprocket pitch diameters. iii. Determine the shortest advisable centre distance. iv. Determine the number of links of chain required.	Understand	4
5	An overhung pulley transmits 35kW at 240rpm. The belt drive is vertical & the angle of wrap may be taken as 180° . The distance of the pulley centre line from the nearest bearing is 350rpm. $\mu = 0.25$. The section of the arm may be taken as elliptical, the major axis being twice the minor axis. The following stress may be taken for design purpose: Shaft & Key: Tension & Compression-80MPa; Shear-50MPa Belt: Tension-2.5MPa Pulley rim: Tension-4.5MPa Pulley arms: Tension-15MPa Determine: a. Diameter of the pulley b. Diameter of the shaft	Understand	4
6	A rope drive is to transmit 250kW from a pulley of 1.2m diameter, running at a speed of 300rpm. The angle of lap may be taken as π radians. The groove angle is 22.5° . The ropes to be used are 50mm in diameter. The mass of the rope is 1.3kg per meter length and each rope has a maximum pull of 2.2kN, the coefficient of friction between rope and pulley is 0.3. If the overhung of the pulley is 0.5m, suggest suitable size for the pulley shaft if it is made of steel with a shear stress of 40MPa. Determine: a. The number of ropes required. b. Diameter for the pulley shaft.	Understand	4
7	An overhung pulley transmits 35kW at 240rpm. The belt drive is vertical & the angle of wrap may be taken as 180° . The distance of the pulley centre line from the nearest bearing is 350rpm. $\mu = 0.25$. The section of the arm may be taken as elliptical, the major axis being twice the minor axis. The following stress may be taken for design purpose: Shaft & Key: Tension & Compression-80MPa; Shear-50MPa Belt: Tension-2.5MPa Pulley rim: Tension-4.5MPa Pulley arms: Tension-15MPa Determine: a. Diameter of the pulley b. Diameter of the shaft	Understand	4
8	Design a belt drive pulley for transmitting 10kW at 180 rpm. The velocity of the belt is not to exceed 10m/s, and the maximum tension is not to exceed 15N/mm width. The tension on the slack is one half of that on the tight side. Determine: a. Width of the pulley b. Diameter of the pulley	Understand	4
9	Design a roller chain to transmit power from a 20kW motor to a reciprocating pump. The pump is to operate continuously 24 hours per day.	Understand	4

S. No	Question	Blooms Taxonomy Level	Program Outcome
	The speed of the motor is 600 r.p.m. and that of the pump is 200 r.p.m. Find 1. Number of teeth on each sprocket; 2. Pitch and width of the chain.		
10	A V-belt drive system transmits 100 kW at 475r.p.m. the belt has a mass of 0.6kg/m. The maximum permissible tension in the belt is 900N. The groove angle is 38° and the angle of contact is 160° . Find minimum number of belts and pulley diameter. The coefficient of friction between belt and pulley is 0.2	Understand	4
11	Design a belt drive pulley for transmitting 20kW at 150 rpm. The velocity of the belt is not to exceed 10m/s, and the maximum tension is not to exceed 25N/mm width. The tension on the slack is one half of that on the tight side. Determine: a. Width of the pulley b. Diameter of the pulley	Understand	4
12	A bucket elevator is to be driven by a gear motor and roller chain drive gear motor=15kW; Speed of gear motor=150 rev/min; Load=16kN, Centre distance = 1220 mm. Elevator will operate 16-24 hrs per day. Select the chain.	Understand	4
13	A rope drive is to transmit 250kW from a pulley of 1.2m diameter, running at a speed of 320rpm. The angle of lap may be taken as π radians. The groove angle is 25° . The ropes to be used are 50mm in diameter. The mass of the rope is 1.3kg per meter length and each rope has a maximum pull of 2.2kN, the coefficient of friction between rope and pulley is 0.3. if the overhung of the pulley is 0.5m, suggest suitable size for the pulley shaft if it is made of steel with a shear stress of 30MPa. Determine: a. The number of ropes required. b. Diameter for the pulley shaft.	Understand	4
14	A roller chain operating under steady load conditions transmits 5kW from a shaft rotating at 650rev/min to one operating at 800rev/min. i. Determine the chain required using at least 15 teeth in sprockets. ii. Determine the sprocket pitch diameters. iii. Determine the shortest advisable centre distance. iv. Determine the number of links of chain required.	Understand	4
15	A V-belt drive system transmits 100 kW at 450r.p.m. the belt has a mass of 0.6kg/m. The maximum permissible tension in the belt is 900N. The groove angle is 35° and the angle of contact is 160° . Find minimum number of belts and pulley diameter. The coefficient of friction between belt and pulley is 0.25.	Understand	4
16	Design a roller chain to transmit power from a 25kW motor to a reciprocating pump. The pump is to operate continuously 24 hours per day. The speed of the motor is 500 r.p.m. and that of the pump is 250 r.p.m. Find 1. Number of teeth on each sprocket; 2. Pitch and width of the chain.	Understand	4
17	An overhung pulley transmits 30kW at 250rpm. The belt drive is vertical & the angle of wrap may be taken as 165° . The distance of the pulley centre line from the nearest bearing is 350rpm. $\mu = 0.3$. The section of the arm may be taken as elliptical, the major axis being twice the minor axis. The following stress may be taken for design purpose: Shaft & Key: Tension & Compression-80MPa; Shear-50MPa Belt: Tension-2.5MPa Pulley rim: Tension-4.5MPa Pulley arms: Tension-15MPa Determine: a. Diameter of the pulley b. Diameter of the shaft	Understand	4
18	A roller chain operating under steady load conditions transmits 6kW from a shaft rotating at 550rev/min to one operating at 750rev/min.	Understand	4

S. No	Question	Blooms Taxonomy Level	Program Outcome
	i. Determine the chain required using at least 15 teeth in sprockets. ii. Determine the sprocket pitch diameters. iii. Determine the shortest advisable centre distance. iv. Determine the number of links of chain required.		
19	Design a belt pulley for transmitting 15kW at 150 rpm. The velocity of the belt is not to exceed 10m/s and the maximum tension is not to exceed 15N/mm width. The tension on the slack side is one half that on the tight side. Determine all the principle dimensions of the pulley.	Understand	4
20	A belt, 100 x 10mm is transmitting power at 15m/s. the angle of contact on the driver (smaller) pulley is 165° , if the permissible stress for the belt material is 2N/mm^2 ; determine the power that can be transmitted at this speed. Take the density of leather as 1000kg/m^3 and coefficient of friction as 0.3. Calculate the maximum power that can be transmitted	Understand	4

PART – C (ANALYTICAL QUESTIONS)

1	<p>The layout of the leather belt drive transmitting 15 kW power is shown in Fig.1. The centre distance between the pulleys is twice the diameter of the big pulley. The belt should operate at a velocity of 20 m/s and the stresses in the belt should not exceed 2.25 MPa. The density of the leather belt is 0.95 g/cc and the coefficient of friction is 0.35. The thickness of the belt is 5 mm. Calculate:</p> <p>i) Diameter of the pulleys. ii) The length and width belts. iii) Belt tensions.</p> 	Understand	4
2	A nylon core flat belt 200 mm wide weighing 20 N/m, connected a 300 mm diameter pulley to a 900 mm diameter driven pulley at a shaft spacing of 6 m, transmits 55.2kW at a belt speed of 25 m/s: i) Calculate the belt length and the angles of wrap ii) Compute the belt tensions based on a coefficient of friction 0.38.	Understand	
3	Design a belt pulley for transmitting 12kW at 170 rpm. The velocity of the belt is not to exceed 12m/s and the maximum tension is not to exceed 15N/mm width. The tension on the slack side is one half that on the tight side. Determine all the principle dimensions of the pulley.	Understand	4
4	A bucket elevator is to be driven by a gear motor and roller chain drive gear motor=9kW; Speed of gear motor=100 rev/min; Load=11kN, Centre distance = 1220 mm. Elevator will operate 16-24 hrs per day. Select the chain.	Understand	4
5	<p>A roller chain operating under steady load conditions transmits 4.5kW from a shaft rotating at 650rev/min to one operating at 850rev/min.</p> <p>i. Determine the chain required using at least 15 teeth in sprockets. ii. Determine the sprocket pitch diameters. iii. Determine the shortest advisable centre distance. iv. Determine the number of links of chain required.</p>	Understand	4
6	An overhung pulley transmits 45kW at 240rpm. The belt drive is vertical & the angle of wrap may be taken as 180° . The distance of the pulley centre line from the nearest bearing is 350rpm. $\mu = 0.25$.	Understand	4

S. No	Question	Blooms Taxonomy Level	Program Outcome
	The section of the arm may be taken as elliptical, the major axis being twice the minor axis. The following stress may be taken for design purpose: Shaft & Key: Tension & Compression-85MPa; Shear-60MPa Belt: Tension-2.5MPa Pulley rim: Tension-4.5MPa Pulley arms: Tension-15MPa Determine: a. Diameter of the pulley b. Diameter of the shaft		
7	A V-belt drive system transmits 90 kW at 550r.p.m. the belt has a mass of 0.6kg/m. The maximum permissible tension in the belt is 900N. The groove angle is 35° and the angle of contact is 150° . Find minimum number of belts and pulley diameter. The coefficient of friction between belt and pulley is 0.25.	Understand	4
8	A chain drive using bush roller chain transmits 5.6KW of power. The driving shaft on an electric motor runs at 1440 rpm and velocity ratio is 5. The centre distance of the drive is restricted to $550 \pm 2\%$ mm and allowable pressure on the pivot joint is not to exceed 10 N/mm ² . The drive is required to operate continuously with periodic lubrication and driven machine is such that load can be regarded as fairly constant with jerk and impact. Design the chain drive by calculating leading dimensions, number of teeth on the sprocket and specify the breaking strength of the chain. Assume a factor of safety of 13.	Understand	4
9	Design a belt pulley for transmitting 18kW at 190 rpm. The velocity of the belt is not to exceed 12m/s and the maximum tension is not to exceed 15N/mm width. The tension on the slack side is one half that on the tight side. Determine all the principle dimensions of the pulley.	Understand	4
10	A belt, 130 x 13mm is transmitting power at 17m/s. the angle of contact on the driver (smaller) pulley is 155° , if the permissible stress for the belt material is 2N/mm ² ; determine the power that can be transmitted at this speed. Take the density of leather as 1000kg/m ³ and coefficient of friction as 0.3. Calculate the maximum power that can be transmitted	Understand	4
UNIT - IV			
PART – A (SHORT ANSWER QUESTIONS)			
1	Discuss the design procedure of spur gears?	Understand	5
2	Derive Lewis equation for beam strength of gear tooth on spur gears	Understand	5
3	Write expressions for static limiting wear load, dynamic load for gear tooth of spur gear explain various terms used there in	Remember	5
4	Explain the following terms used in helical gears. (i). Helix angle (ii) Normal Pitch (iii) Axial Pitch	Understand	5
5	What are the various forces acting on a bevel gear?	Remember	5
6	Derive Lewis equation of beam strength for bevel gear teeth?	Remember	5
7	Discuss design procedure for bevel gears	Understand	5
8	Derive equation for formative number of teeth in bevel gears?	Understand	5
9	What are the various forces acting on worm and worm gears?	Remember	5
10	Explain axial pitch lead angle pressure angle and pitch diameter of worm with the help of a sketch	Understand	5
11	Write a short note on gear drives giving their merits and demerits	Remember	5
12	How are the gears classified?	Remember	5
13	Explain the following terms used in helical gears (a) Helix angle (b) Normal pitch (c) Axial pitch	Understand	5

S. No	Question	Blooms Taxonomy Level	Program Outcome
14	How shaft and arms for spur gears are designed?	Understand	5
15	What conditions must be satisfied in order that a pair of spur gears may have a constant velocity?	Remember	5
16	What is herringbone gear? Where they are used?	Remember	5
17	What are the various terms used in spur gear terminology?	Remember	5
18	Mention four important types of gears and discuss their applications and their materials used.	Remember	5
19	Define formative or virtual number of teeth of a helical gear.	Remember	5
20	State the two most important reasons for adopting involute curves for a gear tooth profile.	Understand	5
PART – B (LONG ANSWER QUESTIONS)			
1	The following particulars of a single reduction spur gear are given, Gear ratio=10:1; Distance between centers =660mm approximately; pinion transmits 500kw at 1800rpm; Involute teeth of standard proportions (addendum=1m) with pressure angle of 22.5° ; Permissible normal pressure between teeth =175N per mm of width. Find i. The nearest standard module if no interference is to occur. ii. The number of teeth on wheel; iii. The necessary width of pinion iv. The load on the bearings of the wheels due to power transmitted.	Understand	5
2	What should be module. Face width and number of teeth on each pair of spur gears. C45 steel pinion is driving a cast iron gear if they have to transmit 18.25 KW at 700 rpm of 0.18 meter pinion in continuous service velocity ratio is 3. Gear teeth are 20° FDI and load is smooth.	Understand	5
3	Design a pair of spur gears to transmit 18 KW at 3000 rpm of pinion. Velocity ratio required is 6:1. Design should be as compact as possible.	Understand	5
4	A pair of helical gears is to transmit 15KW. The teeth are 20° stub in diametric plane and have a helix angle of 45° . The pinion runs at 10,000rpm and has 8mm pitch diameter. The gear has 320mm pitch diameter. If the gears are made of cast steel having allowable static strength of 100Mpa. Determine a suitable module and face width from static strength considerations.	Understand	5
5	A pair of cast iron bevel gears connects 2 shafts at right angles, The pitch diameters of the pinion and gear are 80mm and 100mm respectively. The tooth profiles of the gears of $14\frac{1}{2}^{\circ}$ composite form. The allowable static stress for both the gears is 55Mpa. If the pinion transmits 2.75kw at 1100rpm. Find the module and number of teeth on each gear from the stand point of strength.	Understand	5
6	A pair of bevel gears transmitting 5KW at 360 rpm of pinion, pressure angle is 20° . Determine components of resultant force on the gear teeth. Sketch the free body diagram of the forces acting on mating gear teeth.	Understand	5
7	A pair of cast iron bevel gears connects two shafts at right angle. Pitch diameter of pinion and gear are 80mm & 120mm respectively. Tooth profile is $14\frac{1}{2}^{\circ}$ static strength of both the gears in 56Mpa. Power transmitted is 2.5Kw. at 1200rpm. Determine module of the gear from strength point of view. Check design for wear.	Understand	5
8	Two shafts inclined at 60° are connected by the pair of bevel gears to transmit 9KW at 900 rpm of 24 teeth cast steel pinion gear is made of high grade cast iron and is to rotate at 300 rpm teeth are 14.5° involute form. Find module of gear teeth.	Understand	5
9	A worm drive transmits 15KW at 2000 rpm to a machine carriage at 75rpm. The worm is triple threaded and has 65mm pitch diameter. The worm gear has 90 teeth of 6mm module. The tooth form is to be 20° full	Understand	5

S. No	Question	Blooms Taxonomy Level	Program Outcome
	depth involute. The coefficient of friction between the mating teeth may be taken as 0.10. Calculate i. Tangential force acting on the worm ii. Axial thrust and separating force on worm iii. Efficiency of the worm drive.		
10	Find power transmission capacity of 20:1 worm gear reduction unit that has quadruple to threaded worm and centre distance of 350mm. take module as 8 and input speed to worm is 1000rpm.	Understand	5
11	The following particulars of a single reduction spur gear are given, Gear ratio=15:1; Distance between centers =660mm approximately; pinion transmits 500kw at 1800rpm; Involute teeth of standard proportions (addendum=1m) with pressure angle of 22.5° ; Permissible normal pressure between teeth =175N per mm of width. Find i. The nearest standard module if no interference is to occur. ii. The number of teeth on wheel; iii. The necessary width of pinion iv. The load on the bearings of the wheels due to power transmitted.	Understand	5
12	What should be module, Face width and number of teeth on each pair of spur gears if C45 steel pinion is driving a cast iron gear if they have to transmit 20 KW at 900 rpm of 0.2 meter pinion in continuous service velocity ratio is 3. Gear teeth are 20° FDI and load is smooth.	Understand	5
13	Design a pair of spur gears to transmit 20 KW at 2800 rpm of pinion. Velocity ratio required is 6:1. Design should be as compact as possible.	Understand	5
14	A pair of helical gears is to transmit 18KW. The teeth are 20° stub in diametric plane and have a helix angle of 35° . The pinion runs at 8000rpm and has 6mm pitch diameter. The gear has 320mm pitch diameter. If the gears are made of cast steel having allowable static strength of 150Mpa. Determine a suitable module and face width from static strength considerations.	Understand	5
15	A pair of cast iron bevel gears connects 2 shafts at right angles, The pitch diameters of the pinion and gear are 70mm and 90mm respectively. The tooth profiles of the gears of $14\frac{1}{2}^{\circ}$ Composite form. The allowable static stress for both the gears is 65Mpa. If the pinion transmits 2.75kw at 1300rpm. Find the module and number of teeth on each gear from the stand point of strength.	Understand	5
16	A pair of bevel gears transmitting 8KW at 400 rpm of pinion, pressure angle is 22° . Determine components of resultant force on the gear teeth. Sketch the free body diagram of the forces acting on mating gear teeth.	Understand	5
17	A pair of cast iron bevel gears connects two shafts at right angle. Pitch diameter of pinion and gear are 90mm & 130mm respectively. Tooth profile is 15.5° , static strength of both the gears in 50Mpa. Power transmitted is 2.5KW at 1400rpm. Determine module of the gear from strength point of view. Check design for wear.	Understand	5
18	Two shafts inclined at 50° are connected by the pair of bevel gears to transmit 10KW at 1000 rpm of 24 teeth cast steel pinion gear is made of high grade cast iron and is to rotate at 400 rpm teeth are 14.5° involute form. Find module of gear teeth.	Understand	5
19	A worm drive transmits 17KW at 2200 rpm to a machine carriage at 65rpm. The worm is triple threaded and has 60mm pitch diameter. The worm gear has 90 teeth of 6mm module. The tooth formed is to be 20° full depth involute. The coefficient of friction between the mating teeth may be taken as 0.15. Calculate i. Tangential force acting on the worm ii. Axial thrust and separating force on worm iii. Efficiency of the worm drive.	Understand	5

S. No	Question	Blooms Taxonomy Level	Program Outcome
20	Find power transmission capacity of 15:1 worm gear reduction unit that has quadruple to threaded worm and centre distance of 250mm. take module as 8 and input speed to worm is 1200rpm.	Understand	5

PART – C (ANALYTICAL QUESTIONS)

1	Design a pair of spur gears to transmit 20 kW of power at a pinion speed of rpm. The required velocity ratio 3.5: 120 ⁰ stub involutes tooth profile to be The static design stress for the pinion is 1000 MPa and for the gear is 70 MPa pinion has 16 teeth. Determine the module, face width, and pitch circle diameter of the gears based on a service factor is 1.25.	Understand	5
2	Hardened steel worm rotates at 1250 r/min and transmits power to a phosphor bronze gear with a transmission ratio of 15:1. The centre distance is to be 225 mm. Design the gear drive and give estimated power input ratings from the stand point of strength, endurance and heat dissipation. The teeth are of 141/2 full depth involute.	Understand	5
3	A cast steel pinion with an allowable stress of 103 MPa rotating at 900r/min is to drive a cast iron gear at 1440 r/min. The teeth are 20 stub involute and the maximum power to be transmitted is 25 kW. The allowable stress for cast iron gear is 56 MPa. Determine the module, number of teeth on the gears and face-width from the stand point of strength, dynamic load and wear.	Understand	5
4	Two spur gears are to be used for a rock crusher drive and are to be of minimum size. The gears are to be designed for the following requirements. Power to be transmitted is 20 kW; speed of pinion is 1200 rpm, velocity ratio is 3.5 : 1; tooth profile 20° stub Involute. Determine module and face width for strength requirements	Understand	5
5	Pair of mating helical gears has 200 pressure angle in the normal plane. The normal module is 5 mm and the module in the diametral plane is 5.7735 mm. The pitch diameter. of the smaller gear is 115.47 mm. <i>H</i> the transmission ratio is 4:1, calculate i) Helix angle ii) Normal pitch iii) Transverse pitch iv) Number of teeth for each gear v) Addendum vi) Dedendum vii) Whole depth viii) Clearance ix) Tooth thickness x) Working depth xi) Outside diameters xii) Centre distance xiii) Root circle diameters xiv) Base circle diameters	Understand	5
6	A pair of mitre gears have pitch diameter 280 mm and face width of 36 mm run at 250 rpm. The teeth are of 1410 involutes and accurately cut and transmit 6 kW. Neglecting friction angle, find the following: i) Outside diameter of gears ii) Resultant tooth load tangent to pitch cone, iii) Radial load on the pinion iv) Thrust on the pinion. Assume low carbon cast steel 0.2%C heat treated as the material for both the gears.	Understand	5
7	A cast steel 24 teeth spur pinion operating at 1150 r/min transmits 3 kW to a cast steel 156 teeth spur gear. The gears have the following specifications: Module: 3mm Allowable stress: 100 MPa Face width: 35 mm Tooth form: 100 MPa Factor of dynamic loading $C = 350/\text{mm}$ Wear load factor, $K = 0.28 \text{ MPa}$. Determine the induced stress in the weaker gear. Also determine the dynamic load and wear load. Comment on the results.	Understand	5
8	A pump is driven by a 30 kW motor through a pair of right angled bevel speed of the motor is 200 rpm. The pinion on the motor has a pitch circle of 150mm and carries 30 teeth and the gear on the pump shaft carries 40 pinion made of C45 steel untreated where as the gear is made of 0.2% untreated. The teeth are generated to have 200 full depth involute. The gear	Understand	5

S. No	Question	Blooms Taxonomy Level	Program Outcome
	pair is safe from the stand point of bending strength		
9	A pair of bevel gears transmits 7.5 kW at 300rpm of the pinion. The pitch diameters of the pinion and gear at their larger ends are 150mm and 200 mm respectively, and the pressure angle is 20°. Determine the components of the resultant gear tooth force and draw a free body diagram of the forces acting on the pinion and the gear, assuming face width of 40 mm.	Understand	5
10	Following data refer to a worm and worm gear drive that has to transmit 15 kW at 1750 rpm of the worm: Centre distance = 200 mm, Pitch circle diameter of worm = 80 mm, No. of starts = 4, Axial module = 8 mm, Transmission ratio = 20, Tooth form = 20° FDI. The work gear has an allowable bending stress of 55 MPa. The worm is made of hardened and ground steel. Determine (i) the number of teeth on the worm gear, (ii) The lead angle (iii) face width of the worm gear based on the beam strength of the worm gear.	Understand	5
UNIT - V			
PART – A (SHORT ANSWER QUESTIONS)			
1	Show that the efficiency of self locking screws is less than 50%.	Understand	5
2	Discuss the various types of screw threads used for power screws. Give at least two practical applications for each type. Discuss their relative advantages and Disadvantages?	Understand	5
3	Differentiate between differential screw and compound screw?	Understand	5
4	Discuss over hauling and self locking screws	Understand	5
5	why are square threads preferable to V-threads for power transmission	Understand	5
6	What is self locking property of threads and where it is necessary?	Remember	5
7	Describe construction of mechanical screw jack?	Understand	5
8	How does the helix angle influence on the efficiency of square threaded Screw?	Understand	5
9	In the design of power screws, on what factors does the thread bearing pressure depend? Explain	Understand	5
10	On what factors does the thread bearing pressure depend in the design of power screw? Explain.	Understand	5
11	Why is a separate nut preferable to an integral nut with the body of a screw jack?	Understand	5
12	What do you understand by overhauling of screw?	Understand	5
13	Write a short note on multiple threads	Understand	5
14	What are the stresses induced in power screws?	Understand	5
15	Write a sort note on differential screw.	Understand	5
16	What are the end conditions that have to be taken while designing a screw in a screw jack against buckling load?	Understand	5
17	Why the load cup of a screw jack is made separate from the head of the spindle?	Understand	5
18	Write a sort note on compound screw.	Understand	5
19	What are power screws?	Remember	5
20	What are the types of screw threads used for power screws?	Remember	5

PART – B (LONG ANSWER QUESTIONS)

S. No	Question	Blooms Taxonomy Level	Program Outcome
1	A vertical screw with single start square threads of 50mm mean diameter and 12.5 pitch is raised against a load of 10KN by means of a hand wheel, the boss of which is threaded to act as nut. The axial load is taken up by a thrust collar which supports the wheel boss and has a mean diameter of 60mm. The coefficient of friction is 0.15 for the screw and 0.18 for the collar. If the tangential force applied by each hand to the wheel is 100N, Find suitable diameter of the hand wheel.	Understand	5
2	The lead screw of a lathe has Acme threads of 50mm outside diameter and 8mm pitch. The screw must exert an axial pressure of 2500N in order to drive the tool carriage. The thrust is carried on a collar 110mm outside diameter and 55mm inside diameter and the lead screw rotates at 30rpm Determine. i. The power required to drive the screw; and ii. The efficiency of the lead screw. Assume a coefficient of friction of 0.15 for the screw and 0.12 for the collar.	Understand	5
3	A power screw having double start square threads of 25mm nominal diameter and 5mm pitch is acted upon by an axial load of 10KN. The outer and inner diameters of screw collar are 50mm and 20mm respectively. The coefficient of threaded friction and collar friction may assume as 0.2 and 0.15 respectively. The screw rotates at 12rpm. Assuming uniform wear condition at the collar and allowable threaded bearing pressure of 5.8N/mm^2 , Find i. The torque required to rotate the screw. ii. Stress in the screw.	Understand	5
4	The following data refers to a screw jack; load to be raised 20KN nominal diameter of the screw is 40mm pitch of the screw is 6mm coefficient of friction between screw and nut is 0.15. Assuming load rotating with the screw, determine torque required to raise and lower the load and efficiency of screw jack.	Understand	5
5	A power screw having double start square thread of 32mm nominal dia and 5mm pitch is acted upon by an axial load of 12KN. The inner and outer diameter of screw collar surfaces is 20mm and 50mm respectively. Coefficient of thread friction and collar friction may be assumed as 0.15 and 0.2 respectively screw rotates at 24rpm. Assume uniform condition permissible thread bearing pressure is 6 MPa. Permissible shear stress across threads of nut and screw is 30 MPa. Determine torque required to rotate the screw and stress induced in the screw?	Understand	5
6	The lead screw of a lathe has Acme threads of 50mm outside diameter and 8mm pitch. The screw must exert an axial pressure of 2500N in order to drive the tool carriage. The thrust is carried on a collar 110mm outside diameter and 55mm inside diameter and the lead screw rotates at 30rpm. Determine (i) the power required to drive the screw and (ii) the efficiency of the lead screw. Assume a coefficient of friction of 0.15 for the screw and 0.12 for the collar.	Understand	5
7	The mean diameter of the square threaded screw having pitch of 10mm is 50mm. A load of 20KN is lifted through a distance of 170mm. Find the work done in lifting the load and the efficiency of the screw, when 1. The load rotates with the screw and 2. The load rests on the loose head which does not rotate with the screw. The external and internal diameter of the bearing surface of the loose head 60mm and 10mm respectively. The coefficient of friction for the bearing surface may be taken as 0.08	Understand	5

S. No	Question	Blooms Taxonomy Level	Program Outcome
8	A vertical two start square threaded screw of a 100mm mean diameter and 20mm pitch supports a vertical load of 18 KN. The axial thrust on the screw is taken by a collar bearing of 250mm outside diameter. Find the force required at the end of a lever which is 400mm long in order to lift and lower the load. The coefficient of friction for the vertical screw and nut is 0.15 and that for collar bearing is 0.20.		
9	An electric motor driven power screw moves a nut in a horizontal plane against a force of 75KN at a speed of 300mm/min. The screw has a single square thread of 6mm pitch on a major diameter of 40mm. The coefficient of friction at screw threads is 0.1. Estimate power of the motor.	Understand	5
10	The cutter of a broaching machine is pulled by square threaded screw of 55mm external diameter and 10mm pitch. The operating nut takes the axial load of 400N on a flat surface of 60mm and 90mm internal and external diameters respectively. If the coefficient of friction is 0.15 for all contact surfaces on the nut, determine the power required to rotate the operating nut when the cutting speed is 6m/min. Also find the efficiency of the screw.	Understand	5
11	A vertical screw with single start square threads of 60mm mean diameter and 13.5 pitch is raised against a load of 12KN by means of a hand wheel, the boss of which is threaded to act as nut. The axial load is taken up by a thrust collar which supports the wheel boss and has a mean diameter of 70mm. The coefficient of friction is 0.15 for the screw and 0.18 for the collar. If the tangential force applied by each hand to the wheel is 100N, Find suitable diameter of the hand wheel.	Understand	5
12	The lead screw of a lathe has Acme threads of 45mm outside diameter and 6mm pitch. The screw must exert an axial pressure of 1800N in order to drive the tool carriage. The thrust is carried on a collar 110mm outside diameter and 55mm inside diameter and the lead screw rotates at 30rpm Determine. i. The power required to drive the screw; and ii. The efficiency of the lead screw. Assume a coefficient of friction of 0.2 for the screw and 0.23 for the collar.	Understand	5
13	A power screw having double start square threads of 35mm nominal diameter and 5mm pitch is acted upon by an axial load of 15KN. The outer and inner diameters of screw collar are 50mm and 20mm respectively. The coefficient of threaded friction and collar friction may assume as 0.2 and 0.15 respectively. The screw rotates at 12rpm. Assuming uniform wear condition at the collar and allowable threaded bearing pressure of 6.8N/mm^2 , Find i. The torque required to rotate the screw. ii. Stress in the screw.	Understand	5
14	The following data refers to a screw jack; load to be raised 22KN nominal diameter of the screw is 30mm, pitch of the screw is 6mm coefficient of friction between screw and nut is 0.25. Assuming load rotating with the screw, determine torque required to raise and lower the load and efficiency of screw jack.	Understand	5
15	A power screw having double start square thread of 32mm nominal dia and 5mm pitch is acted upon by an axial load of 12KN. The inner and outer diameter of screw collar surfaces is 20mm and 50mm respectively. Coefficient of thread friction and collar friction may be assumed as 0.15 and 0.2 respectively screw rotates at 28rpm. Assume uniform condition permissible thread bearing pressure is 6 Mpa. Permissible shear stress across threads of nut and screw is 32 Mpa. Determine torque required to rotate the screw and stress induced in the screw?	Understand	5
16	The lead screw of a lathe has Acme threads of 55mm outside diameter and 6mm pitch. The screw must exert an axial pressure of 2800N in order to drive the tool carriage. The thrust is carried on a collar 110mm outside	Understand	5

S. No	Question	Blooms Taxonomy Level	Program Outcome
	diameter and 45mm inside diameter and the lead screw rotates at 40rpm. Determine (i) the power required to drive the screw and (ii) the efficiency of the lead screw. Assume a coefficient of friction of 0.25 for the screw and 0.22 for the collar.		
17	The mean diameter of the square threaded screw having pitch of 12mm is 55mm. A load of 25KN is lifted through a distance of 180mm. Find the work done in lifting the load and the efficiency of the screw, when 1. The load rotates with the screw and 2. The load rests on the loose head which does not rotate with the screw. The external and internal diameter of the bearing surface of the loose head 60mm and 10mm respectively. The coefficient of friction for the bearing surface may be taken as 0.06.	Understand	5
18	A vertical two start square threaded screw of a 120mm mean diameter and 18mm pitch supports a vertical load of 20 KN. The axial thrust on the screw is taken by a collar bearing of 250mm outside diameter. Find the force required at the end of a lever which is 400mm long in order to lift and lower the load. The coefficient of friction for the vertical screw and nut is 0.15 and that for collar bearing is 0.20.	Understand	5
19	An electric motor driven power screw moves a nut in a horizontal plane against a force of 65KN at a speed of 250mm/min. The screw has a single square thread of 5mm pitch on a major diameter of 40mm. The coefficient of friction at screw threads is 0.2. Estimate power of the motor.	Understand	5
20	The cutter of a broaching machine is pulled by square threaded screw of 65mm external diameter and 12mm pitch. The operating nut takes the axial load of 450N on a flat surface of 60mm and 90mm internal and external diameters respectively. If the coefficient of friction is 0.25 for all contact surfaces on the nut, determine the power required to rotate the operating nut when the cutting speed is 6m/min. Also find the efficiency of the screw.	Understand	5
PART – C (ANALYTICAL QUESTIONS)			
1	A power screw having double start square threads of 35mm nominal diameter and 5mm pitch is acted upon by an axial load of 15KN. The outer and inner diameters of screw collar are 50mm and 20mm respectively. The coefficient of threaded friction and collar friction may assume as 0.25 and 0.15 respectively. The screw rotates at 12rpm. Assuming uniform wear condition at the collar and allowable threaded bearing pressure of 5.8N/mm^2 , Find i. The torque required to rotate the screw. ii. Stress in the screw.	Understand	5
2	The following data refers to a screw jack; load to be raised 22KN nominal diameter of the screw is 42mm pitch of the screw is 6mm coefficient of friction between screw and nut is 0.15. Assuming load rotating with the screw, determine torque required to raise and lower the load and efficiency of screw jack.	Understand	5
3	A power screw having double start square thread of 38mm nominal dia and 5mm pitch is acted upon by an axial load of 14KN. The inner and outer diameter of screw collar surfaces is 20mm and 50mm respectively. Coefficient of thread friction and collar friction may be assumed as 0.15 and 0.2 respectively screw rotates at 26rpm. Assume uniform condition Permissible thread bearing pressure is 6 MPa. Permissible shear stress across threads of nut and screw is 30 MPa. Determine torque required to rotate the screw and stress induced in the screw?	Understand	5

S. No	Question	Blooms Taxonomy Level	Program Outcome
4	The lead screw of a lathe has Acme threads of 60mm outside diameter and 8mm pitch. The screw must exert an axial pressure of 2500N in order to drive the tool carriage. The thrust is carried on a collar 100mm outside diameter and 55mm inside diameter and the lead screw rotates at 50rpm. Determine (i) the power required to drive the screw and (ii) the efficiency of the lead screw. Assume a coefficient of friction of 0.13 for the screw and 0.12 for the collar.	Understand	5
5	The mean diameter of the square threaded screw having pitch of 12mm is 45mm. A load of 40KN is lifted through a distance of 170mm. Find the work done in lifting the load and the efficiency of the screw, when 1. The load rotates with the screw and 2. The load rests on the loose head which does not rotate with the screw. The external and internal diameter of the bearing surface of the loose head 60mm and 10mm respectively. The coefficient of friction for the bearing surface may be taken as 0.1	Understand	5
6	A vertical two start square threaded screw of a 120mm mean diameter and 20mm pitch supports a vertical load of 20 KN. The axial thrust on the screw is taken by a collar bearing of 250mm outside diameter. Find the force required at the end of a lever which is 450mm long in order to lift and lower the load. The coefficient of friction for the vertical screw and nut is 0.15 and that for collar bearing is 0.20.	Understand	5
7	An electric motor driven power screw moves a nut in a horizontal plane against a force of 65KN at a speed of 350mm/min. The screw has a single square thread of 6mm pitch on a major diameter of 40mm. The coefficient of friction at screw threads is 0.1. Estimate power of the motor.	Understand	5
8	The cutter of a broaching machine is pulled by square threaded screw of 54mm external diameter and 12mm pitch. The operating nut takes the axial load of 450N on a flat surface of 60mm and 90mm internal and external diameters respectively. If the coefficient of friction is 0.15 for all contact surfaces on the nut, determine the power required to rotate the operating nut When the cutting speed is 6m/min. Also find the efficiency of the screw.	Understand	5
9	A vertical screw with single start square threads of 60mm mean diameter and 12 pitch is raised against a load of 15KN by means of a hand wheel, the boss of which is threaded to act as nut. The axial load is taken up by a thrust collar which supports the wheel boss and has a mean diameter of 80mm. The coefficient of friction is 0.15 for the screw and 0.18 for the collar. If the tangential force applied by each hand to the wheel is 120N, Find suitable diameter of the hand wheel.	Understand	5
10	The lead screw of a lathe has Acme threads of 40mm outside diameter and 7mm pitch. The screw must exert an axial pressure of 1600N in order to drive the tool carriage. The thrust is carried on a collar 110mm outside diameter and 55mm inside diameter and the lead screw rotates at 50rpm Determine. i. The power required to drive the screw; and ii. The efficiency of the lead screw. Assume a coefficient of friction of 0.2 for the screw and 0.23 for the collar.	Understand	5

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