INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonoumas)
Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

TUTORIAL QUESTION BANK
2019 - 2020

Course Name	:	**MACHINE DESIGN**
Course Code	:	AME015
Class	:	B. Tech VI Semester
Branch	:	Mechanical Engineering
Year	:	2019 – 2020
Course Coordinator	:	Dr. G.V.R.Seshagiri Rao Professor
Course Faculty	:	Dr. G. V. R. Seshagiri Rao, Professor Mr. B.Vijay krishna , Assistant Professor

COURSE OBJECTIVES (COs):

The course should enable the students to:

I	Ability to identify design variables and performance factors in the study of journal bearings.
II	Ability to identify different types of rolling contact bearings, their basic features, related terminology and designations
III	Ability to select rolling contact bearings for a given application
IV	Awareness of the basic features of prime movers and the means of power transmission commonly used in mechanical engineering
V	Ability to analyze and design all types of gears for given application

COURSE OUTCOMES (COs):

CO1	Understand various design variables and factors in the study of bearings
CO2	Ability to analyze and design of I.C Engines components.
CO3	Identify the various power transmission systems
CO4	Analyze of forces and design of various gears.
CO5	Ability to identify the different types screws and its terminology.

COURSE LEARNING OUTCOMES (CLOs):

At the end of the course, the student will have the ability to:

CLO Code	Description
AME015.01	Understand various design variables and factors in the study of bearings
AME015.02	Explain various lubrication process
AME015.03	Illustrate various parts of bearing
AME015.04	Analyze heat dissipation in bearings
AME015.05	Select the lubricants for various applications
AME015.06	Discuss types of bearings for required application.

CLO Code	Description
AME015.07	Describe static and dynamic rating of roller bearings
AME015.08	Explain various parts of connecting Rod
AME015.09	Illustrate about thrust acting on a connecting Rod
AME015.10	Categorize & Describe about stresses induced and find suitable cross section
AME015.11	Classify the various types of Crankshafts.
AME015.12	Calculate the sizes of different parts of crankshaft and crank pin
AME015.13	Explain the various parts of the piston and forces acting on each of these parts
AME015.14	Construct the piston diagram and generate formulae
AME015.15	Describe the various types of belt drives and transmission power and V.R
AME015.16	Describe the construction of ropes
AME015.17	Define the efficiency of power transmission and explain factors effecting efficiency
AME015.18	Distinguish different pulleys for belt and rope drives
AME015.19	Describe load transmission between gear teeth and Illustrate dynamic load factors
AME015.20	Compare the equations for compressive and bending strength
AME015.21	Explain the Procedure design of spur gears
AME015.22	Describe the governing equation and find the dynamic and wear strength
AME015.23	Explain Procedure for design of helical and bevel gears
AME015.24	Describe the terminology of power screws
AME015.25	Describe construction and explain failure mechanism

TUTORIAL QUESTION BANK

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
UNIT – I			
PART – A (SHORT ANSWER QUESTIONS)			
1	What is meant by hydrodynamic lubrication?	Understand	AME015.01
2	Explain wedge film and squeeze film journal bearings	Understand	AME015.02
3	Explain Bearing characteristic number for journal bearings	Understand	AME015.03
4	What are the commonly used materials for sliding contact bearings?	Remember	AME015.04
5	Explain the various types of lubrications.	Understand	AME015.05
6	List the important physical characteristics of a good bearing material	Remember	AME015.06
7	Write short note on classifications and different types of antifriction bearings	Understand	AME015.07
8	Define Basic static load rating in rolling contact bearings	Remember	AME015.08
9	Define Basic dynamic load rating in rolling contact bearings	Remember	AME015.09
10	Write some guide lines for selecting a proper type of bearing	Remember	AME015.01
11	Explain Bearing modulus for journal bearings.	Understand	AME015.02
12	Define Static equivalent load rating in rolling contact bearings	Remember	AME015.03
13	Define Dynamic equivalent load rating in rolling contact bearings	Remember	AME015.04
14	What is bearing? And explain its function.	Remember	AME015.05
15	Define rating life and write down the empirical equation.	Remember	AME015.06
16	What is square bearing?	Remember	AME015.07
17	What are the advantages and disadvantages of sliding contact bearings over rolling contact bearings?	Remember	AME015.06
18	Define loading ratio?	Remember	AME015.07

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
19	Discuss reliability of a Bearing.	Remember	AME015.06
20	Write a shot note on lubrication of ball and roller bearings.	Understand	AME015.07
PART – B (LONGANSWER 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 bearings pressure is 1.6 N/mm^2, and Amount of heat to be removed by the lubricant per minute if the bearing temperature is 60^0C and viscosity of the oil at 60^0C is 0.02 kg/ms and the bearing clearance is 0.25 mm.	Understand	AME015.01
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 of 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	AME015.02
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	AME015.03
4	A full journal bearing of 50mm diameter & 100mm long has a bearing pressure of 1.4N/mm^2. The speed of the journal is 900rpm & the ratio of journal diameter to the diametral clearance is 1000. The bearings is lubricated with oil whose absolute viscosity at the operating temperature of 75^0c may be taken as 0.11kg/m-s. The room temperature 35^0c. find the amount of artificial cooling required.	Understand	AME015.04
5	A journal bearing 150mm diameter & 300mm long carries a radial of 9 kN at 1200rpm. The power lost in friction is 6kW. Viscosity of oil at room temperature is 0.018Pa. Find the diametral clearance.	Understand	AME015.05
6	Design a suitable journal bearing for a centrifugal pump from the following available data: Load on the bearing=13.5kN; Diameter of the journal =80mm; Speed=1440r.p.m; Bearing characteristic number at the working temperature (75^0C)=30; Permissible bearing pressure intensity =0.7N/mm^2 to 1.4N/mm^2; Average atmospheric temperature=30^0C. Calculate the cooling requirements. If any?	Understand	AME015.06
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	AME015.06
8	The rolling contact ball bearings are to be selected to support the overhung countershaft. The shaft speed is 720r.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 1kN. 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 manufacture's catalogue, specified at 90% reliability.	Understand	AME015.07
9	Design a self-aligning ball bearings for a radial load of 7000 N and a thrust load of 2100 N. the desired of the bearing is 160 millions of revolutions at 300r.p.m. Assume uniform and steady load.	Understand	AME015.06
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	AME015.07
11	A 150mm diameter shaft supporting a load of 10KN has a speed of	Understand	AME015.03

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	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.		
12	A full journal bearing of 50mm diameter and 100mm long has a bearing pressure of l.4N/mm2• 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	AME015.04
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 lO, 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/mm2 .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 lOoC heat dissipation coefficient=1232W/m2 / Oc	Understand	AME015.05
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	AME015.06
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?	Understand	AME015.03
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 thickness under operating conditions is 0.0125mm.	Understand	AME015.04
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^oC The bearing temp is 60^oC 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^oC is 0.021 N/ms	Understand	AME015.05
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	AME015.06
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	AME015.06
20	A 306 radial ball bearing with inner ring rotation as 8hrs work cycle as follows: Radial force 3KN Axial load 2KN Speed 1200rp Under steady load conditions the basic dynamic load capacity of the bearing is 24.25KN. Determine the expected average life of this	Understand	AME015.07

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	bearing. Take X=0.56 and Y=1.43		
PART – C (ANALYATICAL 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	AME015.01
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/mm2.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^{o}C heat dissipation coefficient=1232W/m2/^{o}C	Understand	AME015.02
3	A full journal bearing of 50mm diameter and 100mm long has a bearing pressure of l.4N/mm2• 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/^{o}C.	Understand	AME015.03
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	AME015.04
5	Design a journal bearing to withstand a load of 5886 N. Speed of the journal is 11 rpm. The journal is made of hardened steel and bearing is made of babbit. Operating Temperature is 70^{0}C and ambient temperature is 30^{0}C. Check the design forth equilibrium and also determine the power loss at the bearing. The lubricant used of grade. SAE 40 lid = 1.5	Understand	AME015.05
6	The following data are given for a full joumal 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	AME015.06
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 x 10^{-3} PaS. The heat generated in the bearing is 442 watts. Determine the maximum speed of the journal using McKee's equation	Understand	AME015.01
8	SAE 20 oil is used to lubricate a hydrodynamic journal bearing of diameter 75nun 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	AME015.02
9	The following data are given for a 3600 hydro - dynamic bearing:	Understand	AME015.03

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	Bearing diameter: 50.02 mm Journal diameter: 49.93 mm Bearing length: 50 mm Journal speed: 1440 *r/min* 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. i) The permissible minimum film thickness. ii) The actual film thickness under the operating conditions. iii) Power loss in friction. iv) Flow requirement		
10	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.	Understand	AME015.01
UNIT – II			
PART – A (SHORT ANSWER QUESTIONS)			
1	Discuss the design of piston for an internal combustion engine	Understand	AME015.08
2	Write a short note on piston rings.	Understand	AME015.09
3	Explain the various stresses induced in the connecting rod	Understand	AME015.10
4	What is the function of a connecting rod of an internal combustion engine?	Remember	AME015.11
5	Discuss about force acting on the connecting rod.	Understand	AME015.11
6	Under what force, the big and end bolts and caps are designed?	Understand	AME015.12
7	At what angle of the crank the twisting moment is maximum in the crank shaft?	Understand	AME015.12
8	What are the methods and materials used in the manufacture of piston	Remember	AME015.12
9	What are the methods and materials used in the manufacture of crankshafts?	Remember	AME015.12
10	State the function of the ribs for an IC engine piston	Remember	AME015.13
11	State the function of the Piston rings for an IC engine piston	Remember	AME015.13
12	State the function of the piston skirt for an IC engine piston	Remember	AME015.14
13	State the function of the piston pin for an IC engine piston	Remember	AME015.14
14	What are the methods and materials used in the manufacture of connecting rod	Remember	AME015.14
15	Discuss on what considerations piston head is designed.	Understand	AME015.14
16	Writ a shot not on required characteristics of piston	Understand	AME015.14
17	What are various types of crank shafts?	Remember	AME015.14
18	Writ a shot notes on whipping stress in connecting rod.	Remember	AME015.14
19	Under what force piston pin and crank pin are designed.	Understand	AME015.14
20	Why I section of connecting rod is used.	Understand	AME015.14
PART – B (LONG ANSWER QUESTIONS)			
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	Understand	AME015.08

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	pulley = 50kN; Total belt pull = 6.5kN. When the crank has turned through 35^0 from the top dead centre, the pressure on the piston is $1N/mm^2$ 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.		
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 $10N/mm^2$ and 15 N/mm^2. The density of material of the rod may be taken as $8000kg/m^3$ and the allowable stress in the bolts as 60 N/mm^2 and in cap as 80 N/mm^2. The rod is to be of I-section for which you can choose your own proportions.. Use Rankine formula for which the numerator constant may be taken as 320 N/mm^2 and the denominator 1/7500.	Understand	AME015.09
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 = $5N/mm^2$; 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 x 103 kJ/kg; Speed = 2000r.p.m. Any other data required for the design may be assumed.	Understand	AME015.08
4	Design a side or overhung crankshaft for a 250x300mm gas engine. The weight of the flywheel is 30KN and the explosion temperature is $2.1N/mm^2$. The gas pressure at the maximum torque is 0.9 N/mm^2, when the crank angle is 35^0 from I.D.C. the connecting rod is 4.5 times the crank radius.	Understand	AME015.09
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	AME015.10
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 = $5N/mm^2$; 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 x 103 kJ/kg; Speed = 2400r.p.m. Any other data required for the design may be assumed.	Understand	AME015.11
7	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	Understand	AME015.11

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	Stroke = 600mm Speed = 200 rev/min I.M.E.P = 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.		
8	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 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	AME015.10
9	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 =46x10^{3}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.	Understand	AME015.11
10	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 3^0) = 3.5N/mm^2.	Understand	AME015.10
11	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 30^0 from I.D.C. the connecting rod is 4.5 times the crank radius.	Understand	AME015.11
12	Design a plain carbon steel centre crankshaft for a single acting four stroke single cylinder engine for the following data: Bore = 250 mm, Stroke =	Understand	AME015.11

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	400 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 30^0 from the top dead centre, the pressure on the piston is $1N/mm^2$ and the torque on the crank is maximum. The connecting rod length 950mm. Assume any other data required for the design.		
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 = $4N/mm^2$; 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 x 103 kJ/kg; Speed = 2000r.p.m. Any other data required for the design may be assumed.	Understand	AME015.12
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= $8000kg/m^3$ 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 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	AME015.10
15	Design a side or overhung crankshaft for a 500x600mm gas engine. The weight of the flywheel is 80KN and the explosion temperature is $2.5N/mm^2$. The gas pressure at the maximum torque is 0.9 N/mm^2, when the crank angle is 35^0 from I.D.C. the connecting rod is 4.5 times the crank radius.	Understand	AME015.11
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 = $4.5N/mm^2$; 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 x 103 kJ/kg; Speed = 1200r.p.m. Any other data required for the design may be assumed.	Understand	AME015.10
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 = $5N/mm^2$; 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 x 103 kJ/kg; Speed = 2400r.p.m. Any other data required for the design may be assumed.	Understand	AME015.11
18	Design a connecting rod with 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	Understand	AME015.11

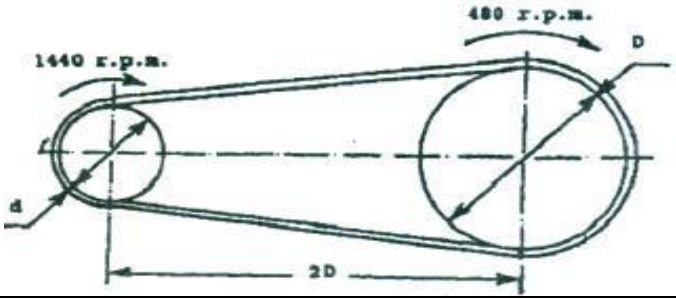
S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	Compression ratio = 6:1 Mass of reciprocating parts per cylinder = 2.25kg Speed = 1200rpm Maximum explosion pressure = 5Mpa Factor of safety=7 Yield strength in compression 350Mpa. Bearing pressure for big end = 7MPa Bearing pressure for small end = 14MPa.		
19	Design high speed petrol engine connecting rod, given: 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= 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 is the flange and web thickness.	Understand	AME015.10
20	Determine the dimensions of I-Section connecting rod diesel engine with the given particulars: Piston diameter = 120mm Stroke length = 140mm Length of the connecting rod= 420mm Rated rpm of the engine =1500 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.	Understand	AME015.12
	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 is100 MPa. The bearing pressure in the gudgeon pin bearing of the connection rod is to be taken as 200 MPa	Understand	AME015.12
2	Explain the considerations given in the design of pistons for IC engines.	Understand	AME015.12
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 30^0 from I.D.C. the connecting rod is 4.5 times the crank radius.	Understand	AME015.13
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	Understand	AME015.14

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	pressure (assumed shortly after dead centre, say at about 3^0) = 4.5N/mm^2.		
5	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.	Understand	AME015.14
6	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 is the flange and web thickness.	Understand	AME015.14
7	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 x 103 kJ/kg; Speed = 2100r.p.m. Any other data required for the design may be assumed.	Understand	AME015.14
8	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 is the flange and web thickness. Determine: a. Dimensions of the crank pin & piston pin	Understand	AME015.14

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	b. Size of the bolts for securing the big end cap.		
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 30^0 from the top dead centre, the pressure on the piston is $1N/mm^2$ and the torque on the crank is maximum. The connecting rod length 950mm. Assume any other data required for the design.	Understand	AME015.14
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	AME015.14
	UNIT – III		
	PART – A (SHORT ANSWER QUESTIONS)		
1	Discuss about the various types of belt drives with neat sketches?	Understand	AME015.15
2	On what a factor does the power transmitted by a belt depends?	Understand	AME015.16
3	How do you classify the chain drives?	Understand	AME015.17
4	Name the type of stresses induced in the wire?	Remember	AME015.15
5	Write in brief on Hoisting and hauling chains, Conveyor chains, and Silent Chains	Understand	AME015.16
6	Under what circumstances a fiber rope and a wire rope is used? What are the advantages of a wire rope over fiber rope?	Understand	AME015.17
7	State the advantages and disadvantages of the chain drive over belt and rope drive.	Remember	AME015.15
8	What are the advantages and disadvantages of V-belt drive over flat belt drive?	Remember	AME015.16
9	Discuss the uses and construction of wire ropes. How is wire rope ends fastened?	Remember	AME015.17
10	Derive the relation for the ratio of driving tensions of a V-belt.	Understand	AME015.15
11	Why the face of a pulley is crowned?	Remember	AME015.15
12	Derive the condition for transmission of maximum power in belt drives.	Remember	AME015.16
13	Discuss different types of pulleys used for belt drives	Remember	AME015.17
14	When a split pulley is used and how it is tightened on a shaft?	Understand	AME015.15
15	Derive the relation for the ratio of driving tensions of a Flat belt.	Remember	AME015.16
16	Explain about fast and loose pulley.	Remember	AME015.17
17	Discuss the procedure used for designing a cast iron pulley	Remember	AME015.15

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
18	What are simplex, duplex and triplex chains?	Remember	AME015.16
19	Write the design procedure for a chain drive	Understand	AME015.17
20	Discuss about classification of chains	Remember	AME015.15
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 156^0, if the permissible stress for the belt material is $2N/mm^2$; determine the power that can be transmitted at this speed. Tale the density of leather as $1000kg/m^3$ and coefficient of friction as 0.25. Calculate the maximum power that can be transmitted	Understand	AME015.15
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	AME015.16
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	AME015.17
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	AME015.15
5	An overhung pulley transmits 35kW at 240rpm. The belt drive is vertical & the angle of wrap may be taken as 180^0. The distance of the pulley centre line from the nearest bearing is 350rpm. μ =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	AME015.16
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 22.5^0. 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	AME015.15
7	An overhung pulley transmits 35kW at 240rpm. The belt drive is vertical & the angle of wrap may be taken as 180^0. The distance of the pulley centre line from the nearest bearing is 350rpm. μ =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:	Understand	AME015.16

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	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		
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	AME015.17
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. 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.	Understand	AME015.15
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 38^0 and the angle of contact is 160^0. Find minimum number of belts and pulley diameter. The coefficient of friction between belt and pulley is 0.2	Understand	AME015.16
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	AME015.17
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	AME015.15
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 25^0. 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	AME015.16
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	AME015.15
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 35^0 and the angle of contact is 160^0. Find minimum number of belts and pulley diameter. The coefficient of friction between belt and pulley is 0.25.	Understand	AME015.16
16	Design a roller chain to transmit power from a 25kW motor to a	Understand	AME015.17

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	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.		
17	An overhung pulley transmits 30kW at 250rpm. The belt drive is vertical & the angle of wrap may be taken as 165^0. The distance of the pulley centre line from the nearest bearing is 350rpm. μ =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	AME015.15
18	A roller chain operating under steady load conditions transmits 6kW from a shaft rotating at 550rev/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	AME015.15
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	AME015.16
20	A belt, 100 x 10mm is transmitting power at 15m/s. the angle of contact on the driver (smaller) pulley is 165^0, if the permissible stress for the belt material is $2N/mm^2$; determine the power that can be transmitted at this speed. Tale the density of leather as $1000kg/m^3$ and coefficient of friction as 0.3. Calculate the maximum power that can be transmitted	Understand	AME015.17
	PART – C (ANALYTICAL Questions)		
1	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: i) Diameter of the pulleys. ii) The length and width belts. iii) Belt tensions. 	Understand	AME015.15
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	Understand	AME015.16

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	length and the angles of wrap ii) Compute the belt tensions based on a coefficient of friction 0.38.		
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	AME015.15
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	AME015.16
5	A roller chain operating under steady load conditions transmits 4.5kW from a shaft rotating at 650rev/min to one operating at 850rev/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	AME015.17
6	An overhung pulley transmits 45kW at 240rpm. The belt drive is vertical & the angle of wrap may be taken as 180^0. The distance of the pulley centre line from the nearest bearing is 350rpm. μ =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-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	Understand	AME015.15
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 35^0 and the angle of contact is 150^0. Find minimum number of belts and pulley diameter. The coefficient of friction between belt and pulley is 0.25.	Understand	AME015.16
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±2% mm and allowable pressure on the pivot joint is not to exceed 10 N/mm2. 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	AME015.17
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	AME015.15
10	A belt, 130 x 13mm is transmitting power at 17m/s. the angle of contact on the driver (smaller) pulley is 155^0, if the permissible stress for the belt material is $2N/mm^2$; determine the power that can be transmitted at this speed. Tale the density of leather as $1000kg/m^3$ and coefficient of friction as 0.3. Calculate the maximum power that can be transmitted	Understand	AME015.15

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	UNIT - IV		
	PART – A (SHORT ANSWER QUESTIONS)		
1	Discuss the design procedure of spur gears?	Understand	AME015.16
2	Derive Lewis equation for beam strength of gear tooth on spur gears	Understand	AME015.16
3	Write expressions for static limiting wear load, dynamic load for gear tooth of spur gear explain various terms used there in	Remember	AME015.16
4	Explain the following terms used in helical gears. (i). Helix angle (ii) Normal Pitch (iii) Axial Pitch	Remember	AME015.16
5	What are the various forces acting on a bevel gear?	Understand	AME015.16
6	Derive Lewis equation of beam strength for bevel gear teeth?		AME015.16
7	Discuss design procedure for bevel gears	Remember	AME015.16
8	Derive equation for formative number of teeth in bevel gears?	Remember	AME015.16
9	What are the various forces acting on worm and worm gears?	Understand	AME015.16
10	Explain axial pitch lead angle pressure angle and pitch diameter of worm with the help of a sketch	Understand	AME015.16
11	Write a shot note on gear drives giving their merits and demerits	Remember	AME015.16
12	How are the gears classified?	Understand	AME015.16
13	Explain the following terms used in helical gears (a) Helix angle (b) Normal pitch (c) Axial pitch	Remember	AME015.16
14	How shaft and arms for spur gears are designed?	Remember	AME015.16
15	What conditions must be satisfied in order that a pair of spur gears may have a constant velocity?	Remember	AME015.16
16	What is herringbone gear? Where they are used?	Remember	AME015.16
17	What are the various terms used in spur gear terminology?	Remember	AME015.16
18	Mention four important types of gears and discuss their applications and their materials used.	Remember	AME015.16
19	Define formative or virtual number of teeth o a helical gear.	Remember	AME015.16
20	State the two most important reasons for adopting involute curves for a gear tooth profile.	Remember	AME015.16
	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; Involutes teeth of standard proportions (addendum=1m) with pressure angle of 22.5^0; 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	AME015.16
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 20^0 FDI and load is smooth.	Understand	AME015.16
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	AME015.16
4	A pair of helical gears is to transmit 15KW. The teeth are 20^0 stub in diametric plane and have a helix angle of 45^0. The pinion runs at 10,000rpm and has 8mm pitch diameter. The gear has 320mm pitch	Understand	AME015.16

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	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.		
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 $1/2^0$ 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	AME015.16
6	A pair of bevel gears transmitting 5KW at 360 rpm of pinion, pressure angle is 20^0. Determine components of resultant force on the gear teeth. Sketch the free body diagram of the forces acting on mating gear teeth.	Understand	AME015.16
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 $141/2^0$ 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	AME015.16
8	Two shafts inclined at 60^0 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 14.5^0 involute form. Find module of gear teeth.	Understand	AME015.16
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 20^0 full 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.	Understand	AME015.16
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	AME015.16
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; Involutes teeth of standard proportions (addendum=1m) with pressure angle of 22.5^0; 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	AME015.16
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 20^0 FDI and load is smooth.	Understand	AME015.16
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	AME015.16
14	A pair of helical gears is to transmit 18KW. The teeth are 20^0 stub in diametric plane and have a helix angle of 35^0. 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	AME015.16
15	A pair of cast iron bevel gears connects 2 shafts at right angles, The pitch	Understand	AME015.16

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	diameters of the pinion and gear are 70mm and 90mm respectively. The tooth profiles of the gears of 14 $1/2^0$ 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.		
16	A pair of bevel gears transmitting 8KW at 400 rpm of pinion, pressure angle is 22^0. Determine components of resultant force on the gear teeth. Sketch the free body diagram of the forces acting on mating gear teeth.	Understand	AME015.16
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 15.5^0, 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	AME015.16
18	Two shafts inclined at 50^0 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 14.5^0 involute form. Find module of gear teeth.	Understand	AME015.16
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 20^0 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	AME015.16
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	AME015.16
	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.	Remember	AME015.16
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	AME015.16
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	AME015.16
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 Involutes. Determine module and face width for strength requirements	Understand	AME015.16
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. *H* the transmission ratio is 4:1, calculate i) Helix angle ii) Normal pitch iii)	Understand	AME015.16

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	Transverse pitch iv) Number of teeth for each gear v) Addendum vi) Dedandum 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		
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	AME015.16
7	A cast steel 24 teeth spur pinion operating at 1150 r/min transmits 3 kW to a cast steel156 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/mm Wear load factor, K = 0.28 MPa. Determine the induced stress in the weaker gear. Also determine the dynamic load and wear load. Comment on the results.	Remember	AME015.16
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 carries40 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 pair is safe from the stand point of bending strength	Remember	AME015.16
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	AME015.16
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 nun 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	AME015.16
UNIT – V			
PART – A (SHORT ANSWER QUESTIONS)			
1	Show that the efficiency of self locking screws is less than 50%.	Understand	AME015.24
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	AME015.24
3	Differentiate between differential screw and compound screw?	Remember	AME015.24
4	Discuss over hauling and self locking screws	Remember	AME015.24
5	why are square threads preferable to V-threads for power transmission	Understand	AME015.24
6	What is self locking property of threads and where it is necessary?		AME015.24

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
7	Describe construction of mechanical screw jack?	Remember	AME015.24
8	How does the helix angle influence on the efficiency of square threaded screw?	Remember	AME015.24
9	In the design of power screws, on what factors does the thread bearing pressure depend? Explain	Understand	AME015.24
10	On what factors does the thread bearing pressure depend in the design of power screw? Explain.	Understand	AME015.24
11	Why is a separate nut preferable to an integral nut with the body of a screw jack?	Remember	AME015.24
12	What do you understand by overhauling of screw?	Understand	AME015.24
13	Write a short note on multiple threads	Remember	AME015.24
14	What are the stresses induced in power screws?	Remember	AME015.24
15	Write a sort note on differential screw.	Remember	AME015.24
16	What are the end conditions that have to be taken while designing a screw in a screw jack against buckling load?	Remember	AME015.24
17	Why the load cup of a screw jack is made separate from the head of the spindle?	Remember	AME015.24
18	Write a sort note on compound screw.	Remember	AME015.24
19	What are power screws?	Remember	AME015.24
20	What are the types of screw threads used for power screws?	Remember	AME015.24
PART – B (LONG ANSWER QUESTIONS)			
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	AME015.24
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	AME015.24
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	AME015.24
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	Understand	AME015.24

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	of screw jack.		
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	AME015.24
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	AME015.24
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	AME015.24
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.	Understand	AME015.24
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	AME015.24
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	AME015.24
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	AME015.24
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.	Understand	AME015.24

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	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.		
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	AME015.24
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	AME015.24
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	AME015.24
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 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.	Understand	AME015.24
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	AME015.24
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	AME015.25
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	AME015.25
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	Understand	AME015.25

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
	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.		
	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	AME015.24
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	AME015.24
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	AME015.24
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	AME015.21
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.	Remember	AME015.22
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	AME015.23
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	AME015.24

S. No	Question	Blooms Taxonomy Level	Course learning Outcome
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.	Remember	AME015.24
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	AME015.25
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.	Remember	AME015.25

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