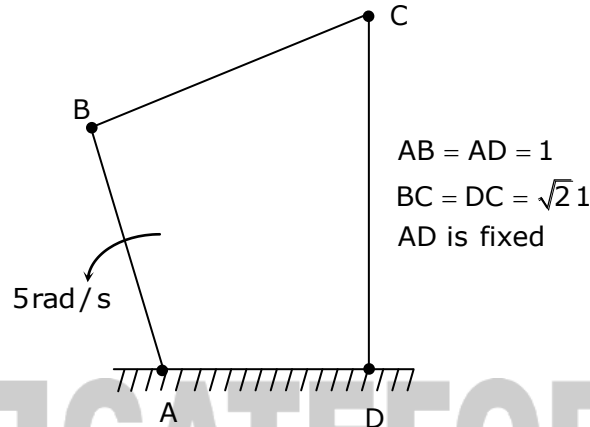**PAPER-II (Conventional)**

1. **(a)**

The driver link AB of a four bar mechanism is rotated at 5.0 rad/s in counter clockwise direction as shown in the above figure. Locate and indicate the Instantaneous Centre (I.C.) of the coupler BC with respect to fixed link AD at an instant when $\angle BAD = 180^O$. Find angular velocity of the coupler using I.C. method only.

$AB = AD = 1$

$BC = DC = \sqrt{2}\, 1$

AD is fixed

5 rad/s

b.

A suitable reverted gear train using four gear wheels is to be used for a clock, the minute hand of which is fixed to the driving spindle and the hour hand to a driven sleeve rotating freely on the same driving spindle axis. The modular pitch is to be kept same for all the wheels and each wheel should have least number of teeth but not 11 or less. Determine number of teeth on each wheel of the gear train.

c.

A rotating disc of 1.0m diameter has two eccentric masses of 0.5 Kg each at radii of 50mm and 60mm with an angular interval between them as 150° on the plane of the disc. A balancing mass of 0.1kg is to be attached in order to balance the disc. What should be the radial distance of the balancing mass from the centre of the disc and its angular position from the eccentric mass which is at 50mm radius?
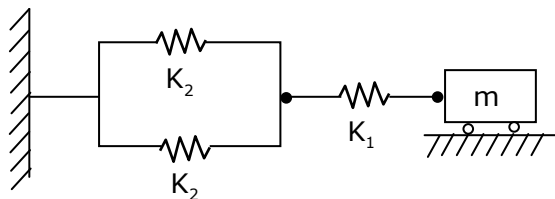

d.

Write down the differential equation of motion for the vibrating system shown in the above figure for free vibration, using D' Alembert's principle and express its natural frequency in Hz, using system parameters as given.

e.

The piston rod of diameter 20mm and length 700mm in a hydraulic cylinder is subjected to a compressive force of 10kN due to internal pressure. The piston end of the rod is guided along the cylinder and the other end of the rod is hinged at the cross-head. The modulus of elasticity for piston rod material is 200 GPa. Estimate the factor of safety taken for the piston and design.
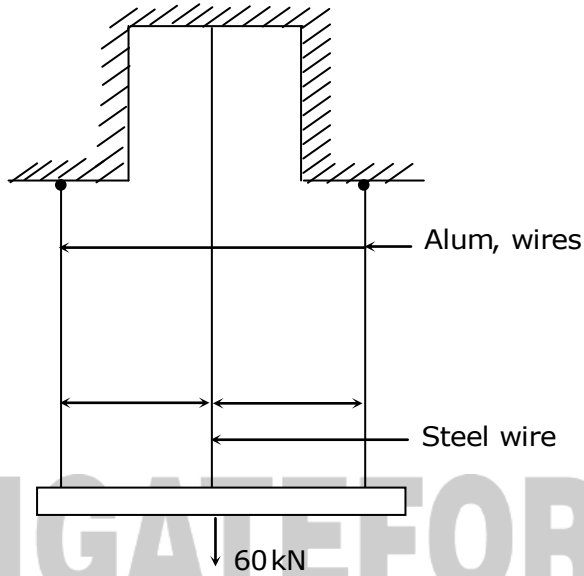
If a load of 60kN is applied to a rigid bar suspended by 3 wires as shown in the above figure what force will be resisted by each wire?
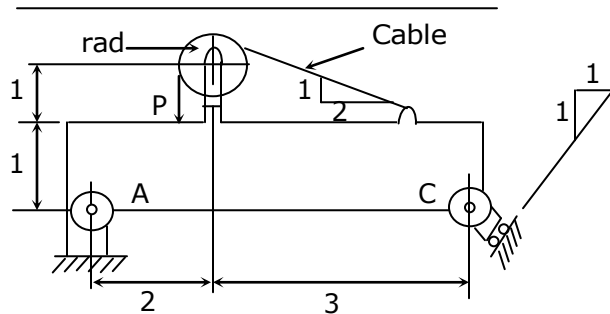
The outside wires are of A1, cross-sectional area 300 mm^2 and length 4 m. The central wire is steel with area 200 mm^2 and length 8m

Initially there is no slack in the wires

$E = 2 \times 10^5$ N/mm^2 for steel

$= 0.667 \times 10^5$ N/mm^2 for Aluminium

g.

For the planar structure shown in the above figure determine the reactions or all the reaction components.

All distances shown are in metres. Radius of the pulley is 0.5m. A load P = 10kN is suspended from the cable.

(h)   Name 5 articles that are made of a thermo-plastic material. Identify the name of the specific plastic used for any 3 of the above applications.

(i)   State clearly the similarities and differences   among   Austennite,   Ferrite   and Cemenetite.

(j)   Name any 3 materials that can be classified as Ceramic. List 2 applications of each.

(k)   What are effects of adding silicon and Manganese to cast iron? Write in short about Zn-base die cast alloys.

(l)   What is meant by interchangeable manufacture? Discuss a 'Go' gauge.

(m)   What are the advantages and disadvantages of a-c welding machine?

(n)   Discuss the terms fineness and particle size distribution in powder metallurgy.

(o)   In GMAW process what is spray transfer and what gas mixtures are used?

(p)   Discuss a fixture, mentioning their materials, what are duplex fixtures?

(q)   Give the symbols, activity names used in method study for charting of the processes.

(r)   What is float or slack and when does a subcritical path becomes critical?

(s)   What is an ideal operating characteristics curve?

(t)   Distinguish between material requirements planning and manufacturing resource planning.

Section 'B'

2.(a)   In order to evaluate mass moment of inertia of a connecting rod the following observations were made during experimentation:

Mass of the connecting rod = 50 kg

Distance between big end bearing and small end bearing centres = 1000mm.

Diameter of big end bearing = 100mm.

Diameter of small end bearing = 50mm.

Time period of oscillation while connecting rod was suspended from big end = 1.75 second Time period of oscillation while connecting rod was suspended from small end = 2.0 second.

Evaluate radius of gyration of the connecting rod about an axis through the centre of mass perpendicular to the plane of oscillation as well as mass moment of inertia of the rod about the same axis.

b.   A machine supported symmetrically on four springs has a total mass of 100 kg. It has unbalance reciprocating parts of 2.0 kg which moves through a vertical stroke of 100mm with simple harmonic motion. The machine is having only one degree of freedom and can undergo vertical displacement. Evaluate its natural frequency and combined stiffness of the springs if the force transmitted to the foundation is one-twentieth of the applied force, when there is no damping in the system. The machine is rotating at 800 rpm.

When the machine is actually tested for vibration, it is found that the damping present in the system reduces the amplitude of successive free vibrations by 30%. Evaluate:

(i)   The actual force transmitted to foundation at the running speed 800 rpm.

(ii)   The force transmitted to foundation at resonance, and

(iii)   The amplitude of vibration of the machine due to unbalance mass, at resonance. 10

c.
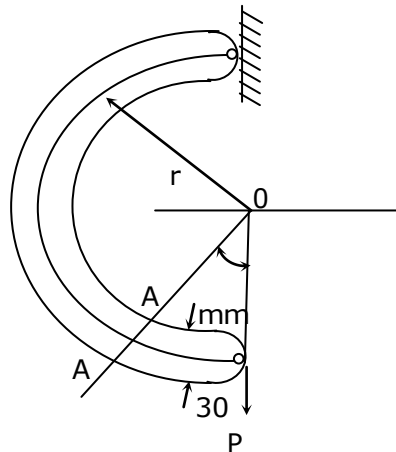
A semicircular steel ring of mean radius 300mm is suspended vertically with the top end fixed as shown in the above figure and carries a vertical load of 200N at the lowest point.

Calculate the vertical deflection of the lower end if the ring is of rectangular cross-section 20mm thick and 30 mm wide.

Value of Elastic modulus is 2×10^5 N/mm^2.

Influence of circumferential and shearing forces may be neglected.

d.

A hollow steel rod 200 mm long is to be used as torsional spring. The ratio of inside to outside diameters is 1 : 2. The required stiff-ness of this spring is 100N.m/degree.

Determine the outside diameter of the rod.

Value of G is 8×10^4 N/mm^2.

3.   **a.**

Determine the maximum and minimum values of the primary and secondary unbalance forces due to reciprocating masses for a 90° V-twin engine, whose details are given below:

Reciprocating mass per cylinder = 2.0kg

Stroke for each cylinder = 12 cm

Connecting and length of each cylinder = 20cm

Crank shaft speed = 2000 rpm

Indicate the crank positions corresponding to above maximum and minimum values of unbalance forces. Whether primary and secondary unbalance forces can be balanced completely are not?

b.

Two railway coaches are coupled with the help of two tie rods of a turn buckle with right and left handed threads having single-start square threads. Pitch. and mean diameter of the threads are 8mm and 30mm respectively. How much energy will be spent in bringing two coaches closer through a distance of 320 mm against a steady load of 5.0kN. Use coefficient of friction in screw thread and coupler nut as 0.12. Determine shear stress on the tie rod due to above torque.

c.

The data obtained from a rectangular strain gauge rosette attached to a stressed steel member are $\in_0 = -220 \times 10^{-6}$, $\in_{45}^o = 120 \times 100^{-6}$, and $\in_{90} = 220 \times 10^{-6}$. Given that the value of $E = 2 \times 10^5 \, N/mm^2$ and Poisson's Ratio $\mu = 0.3$, calculate the values of principal stresses acting at the point and their directions.

A spherical shell of 150mm internal diameter has to withstand an internal pressure of 30 Mega N/m^2. Calculate the thickness of the shell if the allowable stress is 80MN/m².

Assume the stress distribution in the shell to follow the law

$$\sigma_r = a - \frac{2b}{r^3} \text{ and } \sigma_0 = a + \frac{b}{r^3}$$

4.   **a.**

A stiff bar of negligible weight transfer a load P to a combination of three helical spings arranged in parallel as shown in the above figure. The springs are made up of the same material and out of rods of equal diameters. They are of same free length before loading. The number of coils in those three springs are 10,12 and 15 respectively, while the mean coil diameters are in ratio of 1 : 1.2 : 1.4 respectively. Find the distance 'x' as shown in figure, such that the stiff bar remains horizontal after the application of load P.
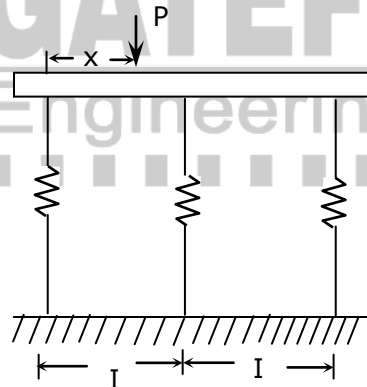
b.

A pair of standard spur gears has 16 and 18 teeth, module 12.5mm and pressure angle 14.5^O. Examine whether the pair will have interference. If so, what should be the number of teeth in both the gears to avoid interference as well as the pair maintains the same speed ratio without modifying other parameters. Evaluate contact ratio for the new set.

c.

A flat belt drive is required to transmit 10kW from a motor running at 1000 rpm. The belt is 15mm thick and has a mass density of 0.001 gm/mm³. Permissible tensile stress for the belt material is 2.5 N/mm². Diameter of the driving pulley is 250mm, whereas the speed of the driven pulley is 367 rpm. Driving and driven shafts are 1.25m apart. The coefficient of friction between belt and pulley may be taken as 0.25. Determine the width of the belt for safe working.

d.

The stress state at a point in a body is plane with $\sigma_1 = 60 \, N/mm^2$ and $\sigma_2 = -36 \, N/mm^2$

If the allowable stress for the material in simple tension or compression is 100 N/mm2 calculate the values of factor of safety with each of the following criteria for failure

(i)   Max Stress Criteria

(ii)   Max Shear stress Criteria

(iii) Max Strain Criteria

(iv)   Max Distortion energy criteria

5.a   i.

How do Ziconium and thorium affect the tungsten electrode in the GTAW process? What is "weld decay" in Ni – Cr steels?

ii.

Is it possible to weld tantalum to steel, if yes, by which method? Explain the term hot cracks in welding and write four-important causes.

iii.

Explain why the strength to weight ratio of die-cast parts increases with decreasing wall thickness. Explain the term stack molding

iv.

Draw the typical configuration of Internal Centreless grinding mentioning main advantage and use. Draw tool life cures for cast alloy, High speed steel and ceramic tools.

b. i.   Explain the difference between infiltration and impregnation in powder metallurgy. Give at least two examples of each.

ii.

Why are the following characteristics of metal important in sheet metal forming

(1)   Grain size and

(2)   Yield point elongation

Why are pure metals more easily cold worked than alloys?

iii.

In the design of the gating system what techniques are used for minimizing turbulence? Show with a figure the effect of alloying elements like Mn, Ni and Ti on the eutectoid temperature.

iv.

Explain with figures planetary milling. Indicate similarities between a vertical boring mill and a jig-boring machine.

6.a   i.

Discuss short circuiting metal transfer in GNAW mentioning its suitability. Also define the term "transition current", with figure.

ii.

Why is a unilateral tolerance preferred over bilateral tolerance? In surface roughness, discuss with a figure Root-Mean-Square average method.

iii.

In metal casting define the terms chaplet and resin binder. Write the merits and demerits of shell molding process.

iv.

What are a manipulator, wrist and end effector for a obot? Why has the wire EDM process become so widely accepted in industry?

b. i

Explain why metal powders are blended. Describe What happens during sintering.

ii

What is meant by Part Programming? Discuss point-to-point control, and its applications.

iii

In FMS define the terms: Automatic Guided Vehicle (AGV) and DNC. Explain the terms chucking reamers and climb million. What effect does the helix angle have on drill performance. Explain the terms combined cuts and multiple cuts.

7.   **(a)**

Transportation costs from manufacturing plants to ware houses are given in table. They are in earros. Solve this problem to minimize the cost of transportation by stating the steps used in the algorithm.

Warehouse	P	L	A	Nt
	A	B	C	D
1	10	8	10	8
2	10	7	9	10
3	11	9	8	7
4	12	14	13	10

(b)

What are moving average and exponential smoothing models for forecasting?

A dealership for Honda City car sells a particular model of the car in various months of the year. Using the moving average method, find the exponential smoothing forecast for the month of October 2010. Take exponential smoothing constant as 0.2:

Jan. 2010	80 cars
Feb. 2010	65 cars
March 2010	90 cars
April. 2010	70 cars
May. 2010	80 cars
June. 2010	100 cars
July. 2010	85 cars
Aug. 2010	60 cars
Sept. 2010	75 cars

Expand the following
(i)   ASCII
(ii)   BCD
(iii) MDI
(iv)   RAM
(v)   ROM