MODEL PAPER-I

SECTION –A

Answer All Questions **(20 Marks)**

1.	What is meant by Gyroscope Couple?	2M
2.	What are the conditions for equilibrium of Three force member?	2M
3.	What is the function of a Clutch?	2M
4.	What is the difference between brake and Dynamometer?	2M
5.	What is meant by fluctuation of Energy?	2M
6.	Classify governors	2M
7.	What do you mean by coupled locomotives and uncoupled locomotives?	2M
8.	What is Tractive force?	2M
9.	What are different types of Vibrations?	2M
10.	What is meant by Whirling of shafts?	2M

SECTION –B

Answer ALL Questions **(5×10= 50 Marks)**

1. Explain what you understand by gyroscopic stabilization. Illustrate with the help of a sketch how this is carried out in ships. The turbine rotor of a ship has a mass of 8 tones and a radius of gyration 0.6 m. It rotates at 1800 r.p.m. clockwise, when looking from the stern. Determine the gyroscopic couple, if the ship travels at 100 km/hr and steer to the left in a curve of 75 m radius.

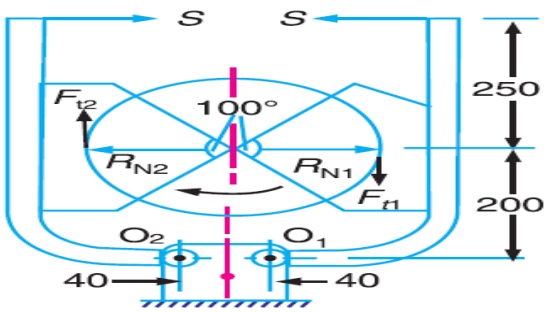
OR

2. Describe, in detail, the complete static force analysis of the system of a reciprocating engine mechanism.

3. A single plate clutch (both sides effective) is required to transmit 26.5 kWat 1600 rpm. The outer diameter of the plate is limited to 300 mm, and the intensity of pressure between the plates is not to exceed 68.5kN/m2. Assuming uniform wear and a coefficient of friction of 0.3, show that the inner diameter of the plate is approximately 90 mm.

OR

4. A double shoe brake, as shown in Fig. is capable of absorbing a torque of 1400 N-m. The diameter of the brake drum is 350 mm and the angle of contact for each shoe is 100°. If the coefficient of friction between the brake drum and lining is 0.4 ; find **1.** the spring force necessary to set the brake ; and **2.** The width of the brake shoes, if the bearing pressure on the lining material is not to exceed 0.3 N/mm2.



All dimensions in mm

5. (a) What are the differences between Porter and Proell Governors?

(b) The arms of a Hartnell governor are of equal length. At the mid position of the sleeve, the ball arm is vertical and the radius at which the ball rotates is 83mm when the equilibrium speed, neglecting friction, is 350 rpm. On changingthe speed by 3

i. the magnitude of the rotating masses
ii. the spring stiffness
iii. the initial compression of the spring

OR

6. The Flywheel of a steam engine has a radius of gyration of 1 m and a mass of 2500 kg. The starting torque of the steam engine is 1500 N-m and may be assumed constant. Determine the i. Angular acceleration of the Fly wheel, and ii. The kinetic energy of the wheel after 10 seconds from the start.

7. A rotating shaft carries four unbalanced masses 18 kg, 14 kg, 16 kg and 12 kg at radii 50 mm, 60 mm, 70 mm and 60 mm respectively. The 2nd, 3rd and 4th masses revolve in planes 80 mm, 160mm and 280 mm respectively measured from the plane of the first mass and are angularly located at 60°, 135° and 270° respectively measured clockwise from the first mass looking from this mass end of the shaft. The shaft is dynamically balanced by two masses, both located at 50 mm radii and revolving in planes mid-way between those of 1st and 2nd masses and midway between those of 3rd and 4th masses. Determine, graphically or otherwise, the magnitudes of the masses and their respective angular positions.

OR

8. A single cylinder engine runs at 250 r.p.m. and has a stroke of 180 mm. The reciprocating parts has a mass of 120 kg and the revolving parts are equivalent to a mass of 70 kg at a radius of 90 mm. A mass is placed opposite to the crank at a radius of 150 mm to balance the whole of the revolving mass and two-thirds of the reciprocating mass. Determine the magnitude of the balancing mass and the resultant residual unbalance force when the crank has turned 30° from the inner dead centre, neglect the obliquity of the connecting rod.

9. A coil of spring sti_ness 60 N/mm supports vertically a load of 3 kN at the free end. The motion is resisted by the oil dashpot. It is found that the amplitude at the beginning

of the fourth cycle is 0.6 times the amplitude of the previous vibration. Find the ratio of the frequencies of damped and undamped vibrations.

OR

10. Derive an expression for the frequency of free torsional vibrations for a shaft fixed at one end and carrying a load on the free end.

MODEL PAPER-II

SECTION –A

Answer All Questions **(10×2=20 Marks)**

1. a) Discuss Precesional angular motion [2M]
   b) Define right hand screw rule [2M]
   c) Define the clutch [2M]
   d) Briefly explain about working of single plate clutch [2M]
   e) Define coefficient of fluctuation of speed [2M]
   f) Describe the function of flywheel [2M]
   g) State why is balancing of rotating parts necessary for high speed engines ?[2M]
   h) Describe are in-line engines ? How are they balanced ? It is possible to balance them completely ? [2M]
   i) Discuss the causes and effects of vibrations ? [2M]
   j) Define, in short, free vibrations, forced vibrations and damped vibrations. [2M]

SECTION –B

Answer All Questions **(5×10=50 Marks)**

1. The turbine rotor of a ship has a mass of 20 tones & a radius of gyration of 0.75m.Its speed is 2000 rpm.the ship pitches 6degrees above & below the horizontal position. One complete oscillation takes 18 sec & the motion is simple harmonic. Determine
(i)The maximum couple tending to shear the holding down bolts of the turbine.
(ii)The maximum angular acceleration of the ship during pitching .
(iii)The direction in which the bow will tend to turn while rising, if the rotation the rotor is clock wise when looking from rear.

OR

2. A car weighs 20KN. It has a wheel base of 2m, Track width 1m & Height of C.G. 300 mm above the ground level & lies midway between the front & rear axle. The engine flywheel rotates at 3000 rpm clockwise when viewed from the front. The moment of inertia of the fly wheel is 4kg-m² & MOI of each wheel is 3 kg-m², Calculate the reactions between the wheels & the ground when car takes the curve of 15m radius towards right at 30 km/hr, taking into consideration the gyroscopic & the centrifugal effects. Each wheel radius is 400mm.

3.The lead screw of the lathe has acme threads of 50 mm outside diameter and 10 mm pitch. The included angle of thread is 29 degrees. It drives a tool carriage and exerts a pressure of 2500N. A collar bearing with outside diameter 100mm and inside diameter 50mm is provided to take up the thrust. If the lead screw rotates at 30 r.p.m. and calculate the efficiency and the power required to drive the screw. The coefficient of friction for the screw threads is 0.15 and for the collar is 0.12.

OR

4. A band brake acts o he 3/4th of circumference of a drum of 450 mm diameter which is keyed to the shaft. the band brake provided a braking torque of 225 N-m. One end of the band is attached to a fulcrum pin of the lever and the other end to a pin 100 mm from the fulcrum. If the operating force is applied at 500 mm from the fulcrum and the coefficient

of friction is 0.25, calculate the operating force when the drum rotates in (a) anti0clockwise, and (b) clockwise direction.

5. The turning moment diagram of a petrol engine is drawn to the following scales: Turning moment, 1mm = 5 N-m; crank angle, 1 mm = 1^0. The turning moment diagram repeats itself at every half revolution of the engine & the areas above & below the mean turning moment line taken in order are 295, 685,40, 340, 960,270 mm^2 . The rotating parts are equivalent to a mass of 36 kg at the radius of gyration of 150 mm. Determine the co efficient of fluctuation of speed when the engine runs at 1800 rpm.

OR

6. The turning moment diagram of a multi cylinder engine is drawn to the following scales: Turning moment, 1mm = 600 N-m vertically;& 1mm = 30 horizontally, The intercepted areas between the output torque curve & the mean resistance line, taken in order from one end, are as follows : +52 -124, +92, -140, + 85, -72 & +107 mm^2. When the engine is running at a speed of 600 rpm. If the total fluctuation of speed is not to exceed± 1.5 % of the mean, Calculate the necessary mass of the flywheel of radius 0.5 m.

7. Four masses m1 ,m2, m3 and m4 are 200 kg , 300 kg , 240 kg , and 260 kg respectively. The corresponding radii of rotation are 0.2m , 0.15m, 0.25m and 0.3m respectively and the angles between successive masses are 45 degree, 35 degree and 135 degree. Calculate the postion and magnitude of the balance mass required, if its radius of the rotation is 0.2m.

OR

8. A,B,C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B,C and D are 10 kg, 5 kg and 4 kg respectively. Calculate the required mass a and the relative angular settings of the four masses so that the shaft shall be in complete balance.

9. A beam of length 10 m carries two loads of mass 200 kg at distances of 3 m from each end together with a central load of mass 1000 kg. Calculate the frequency of transverse vibrations. Neglect the mass of the beam and take I = 109 mm4 and E = 205×103 N/mm2.

OR

10. A steel bar 25 mm wide and 50 mm deep is freely supported at two points 1 m apart and carries amass of 200 kg in the middle of the bar. Neglecting the mass of the bar, Calculate the frequency of transverse vibration .If an additional mass of 200 kg is distributed uniformly over the length of the shaft, what will be the frequency of vibration ? Take E = 200 GN/m2.

MODEL PAPER-III

SECTION –A

Answer All Questions each question carries equal marks (10×2=20 Marks)

1. **a)** Discuss the effect of reactive gyroscopic couple when a naval ship is rolling?

b) Describe the gyroscopic effect on an aeroplane.

c) Discuss the various types of mechanical brakes

d) Discuss the various types of transmission Dynamometers..

e) Discuss the turning moment diagram

f) Draw the turning moment diagram of a single cylinder double acting steam engine?

g) Discuss how a single revolving mass is balanced by two masses revolving in different planes.

h) Explain how the different masses rotating in different planes are balanced ?

i) Derive an expression for the natural frequency of free transverse vibrations for a simply supported

j) Explain the terms 'under damping, critical damping' and 'over damping'

SECTION –B

Answer All Questions (5×10=50 Marks)

1. An aeroplane makes a complete half circle of 50 meters radius, towards left, when flying at 200 kmph. The rotary engine and the propeller of the plane has a mass of 400 kg. and a radius of gyration of 0.3 m. The engine rotates at 2400 r.p.m. clockwise when viewed from the rear. Calculate the gyroscopic couple on the aircraft and state its effect on it.

OR

2. A four wheeled motor car of mass 2000 kg has a wheel base 2.5 m, track width 1.5 m and height of center of gravity 500 mm above the ground level and lies at 1 meter from the front axle. Each wheel has an an effective diameter of 0.8 m and a moment of inertia of 0.8 kg-m^2. The drive shaft, Engine flywheel and transmission are rotating at 4 times the speed of road wheel, in a clockwise direction when viewed from the front, and is equivalent to a mass of 75 kg having a radius of gyration of 100 mm. If the car is taking a right turn of 60 m radius at 60 km/h, Calculate the load on each wheel.

3. A truck has 3.15 m wheel base & the C.G. is 1.28 m in front of the rear axle & 0.9 m above ground level. The co efficient of adhesion between tyres& road is 0.6 & the brakes are applied to the rear wheels only. Calculate the minimum distance in which the truck can be stopped on a level road when travelling at 48 kmph? If the weight of the truck is 8 tones, find the pressure on each wheel during braking?

OR

4. A single plate clutch is required to transmit 26.5 KW at 1600 rpm. The outer diameter of the plate is limited to 300 mm & intensity of the pressure between the plates is not exceeds 68.5 KN/m^2 Assuming uniform wear & co-efficient of friction is μ is 0.3, show that the inner diameter of the plate is approximately 90 mm.

5. The turning moment diagram of a multi cylinder engine is drawn to the following scales: Turning moment, 1mm = 500 N-m vertically;& 1mm = 35 horizontally, The intercepted areas between the output torque curve & the mean resistance line, taken in order from one end, are as follows : +53,-125,+93, -142, + 86, -73 & +108 mm^2. When the engine is running at a speed of 600 rpm. If the total fluctuation of speed is not to exceed± 1.6 % of the mean, Calculate the necessary mass of the flywheel of radius 0.6 m.

OR

6. The mass of the flywheel of an engine is 6.5 tones & the radius of gyration is 1.8 m. It is found from the turning moment diagram that the fluctuation of energy is 56 KN-m. If the mean speed of the engine is 120 rpm, Calculate the maximum & minimum speeds

7. A shaft carrier five masses A,B,C,D and E which revolves at the same radius in planes which are equidistant from one another. The magnitude of the masses in planes A, C and D are 50 kg, 40 kg and 80 kg respectively. The angle between A and C and that between C and D is 135 degrees. Determine the magnitude the masses in planes Band E and their position to put the shaft in complete rotating balance.

OR

8. A,B,C and D are four masses carried by a rotating shaft at radii 100 mm, 150 mm ,150mm and 200mm respectively. The planes in which the masses rotate are spaced at 500mm apart and the magnitude of the masses B,C and D are 9kg,5 kg and 4 kg respectively. Calculate the required mass A and the relative angular settings for the four masses so that the shaft shall in complete balance.

9. A mass of 5 kg is supported by a spring of stiffness 5 kN/m. In addition, the motion of mass by a damper whose resistance is proportional to velocity. The amplitude of vibration reduces to 1/15th of the initial amplitude in four complete cycles. Determine the damping force per unit velocity and the ratio of the frequencies of the damped and undamped vibrations.

OR

10. A shaft 50 mm diameter and 3 meters long is simply supported at the ends and carries three loads of *1000 N,* and *1500 N* and *750 N* at 1 m, 2 m and 2.5 m from the left support. The young's modulus for shaft material is 200 $GN/m^{2.}$ Calculate the frequency of transverse vibration.

MODEL PAPER-IV

SECTION –A

Answer All Questions each question carries equal marks **(10×2=20 Marks)**

1. a) Discuss Precesional angular motion.
b) Describe the gyroscopic effect on an aeroplane.
c) Define the clutch.
d) Briefly explain about working of single plate clutch.
e) What is meant by fluctuation of Energy?
f) Draw the turning moment diagram of a single cylinder double acting steam engine?
g) State why is balancing of rotating parts necessary for high speed engines.
h) Describe are in-line engines? How are they balanced? It is possible to balance them completely?
i) Derive an expression for the natural frequency of free transverse vibrations for a simply supported.
j) Define, in short, free vibrations, forced vibrations and damped vibrations.

SECTION –B

Answer All Questions **(5×10=50 Marks)**

1. The turbine rotor of a ship has a mass of 20 tones & a radius of gyration of 0.75m.Its speed is 2000 rpm.the ship pitches 6degrees above & below the horizontal position. One complete oscillation takes 18 sec & the motion is simple harmonic. Determine
(i)The maximum couple tending to shear the holding down bolts of the turbine.
(ii)The maximum angular acceleration of the ship during pitching .
(iii)The direction in which the bow will tend to turn while rising, if the rotation the rotor is clock wise when looking from rear.

OR

2. Describe, in detail, the complete static force analysis of the system of a reciprocating engine mechanism.
3. A truck has 3.15 m wheel base & the C.G. is 1.28 m in front of the rear axle & 0.9 m above ground level. The co efficient of adhesion between tyres& road is 0.6 & the brakes are applied to the rear wheels only. Calculate the minimum distance in which the truck can be stopped on a level road when travelling at 48 kmph? If the weight of the truck is 8 tones, find the pressure on each wheel during braking?

OR

4. A band brake acts o he 3/4th of circumference of a drum of 450 mm diameter which is keyed to the shaft. the band brake provided a braking torque of 225 N-m. One end of the band is attached to a fulcrum pin of the lever and the other end to a pin 100 mm from the fulcrum. If the operating force is applied at 500 mm from the fulcrum and the coefficient of friction is 0.25, calculate the operating force when the drum rotates in (a) anti0clockwise, and (b) clockwise direction.
5. The turning moment diagram of a multi cylinder engine is drawn to the following scales: Turning moment, 1mm = 500 N-m vertically;& 1mm = 35 horizontally, The intercepted areas between the output torque curve & the mean resistance line, taken in order from one end, are as follows : +53,-125,+93, -142, + 86, -73 & +108 mm^2. When the engine is running at a speed of 600 rpm. If the total fluctuation of speed is not to exceed± 1.6 % of the mean, Calculate the necessary mass of the flywheel of radius 0.6 m.

OR

6. The Flywheel of a steam engine has a radius of gyration of 1 m and a mass of 2500 kg. The starting torque of the steam engine is 1500 N-m and may be assumed constant. Determine the i. Angular acceleration of the Fly wheel, and ii. The kinetic energy of the wheel after 10 seconds from the start.

7. Four masses m1 ,m2, m3 and m4 are 200 kg , 300 kg , 240 kg , and 260 kg respectively. The corresponding radii of rotation are 0.2m , 0.15m, 0.25m and 0.3m respectively and the angles between successive masses are 45 degree, 35 degree and 135 degree. Calculate the postion and magnitude of the balance mass required, if its radius of the rotation is 0.2m.

OR

8. A single cylinder engine runs at 250 r.p.m. and has a stroke of 180 mm. The reciprocating parts has a mass of 120 kg and the revolving parts are equivalent to a mass of 70 kg at a radius of 90 mm. A mass is placed opposite to the crank at a radius of 150 mm to balance the whole of the revolving mass and two-thirds of the reciprocating mass. Determine the magnitude of the balancing mass and the resultant residual unbalance force when the crank has turned 30° from the inner dead centre, neglect the obliquity of the connecting rod

9. A beam of length 10 m carries two loads of mass 200 kg at distances of 3 m from each end together with a central load of mass 1000 kg. Calculate the frequency of transverse vibrations. Neglect the mass of the beam and take I = 109 mm4 and E = 205×103 N/mm2

10. Derive an expression for the frequency of free torsional vibrations for a shaft fixed at one end and carrying a load on the free end.