



Regulation R-20

Subject code: C35PC1

TKR COLLEGE OF ENGINEERING AND TECHNOLOGY

(Autonomous, Accredited by NAAC with 'A' Grade)

Model Paper

B.Tech/M.Tech III Year I Semester Regular Examinations, December 2022

DYNAMICS OF MACHINERY

(MECHANICAL)

Maximum Marks: 70

Duration: 3 hours

Note: 1.This question paper contains two parts A and B.

2. Part A is compulsory which carries 20 marks. Answer all questions in Part A.

3. Part B consists of 5 Units. Answer any one full question from each unit.

4. Each question carries 10 marks and may have a, b, c, d as sub questions.

Part-A


All the following questions carry equal marks

(10x2M=20 Marks)

Q.NO	QUESTIONS	Marks	CO attainment	Blooms Taxonomy Level
1	State the D' Alembert' s principle for Rectilinear motion, and Angular motion.	2	1	L1
2	What do you understand by spin, precession and gyroscopic planes? Explain briefly	2	1	L1
3	What do you understand by ' self-locking brake' and ' self-energized brake' ?	2	2	L1
4	What is the difference between the Porter and Proell governors?	2	2	L2
5	What do you mean by ' Equivalent Inertia force' ?	2	3	L1
6	Explain the terms: Primary distributing force and Secondary distributing force	2	3	L1

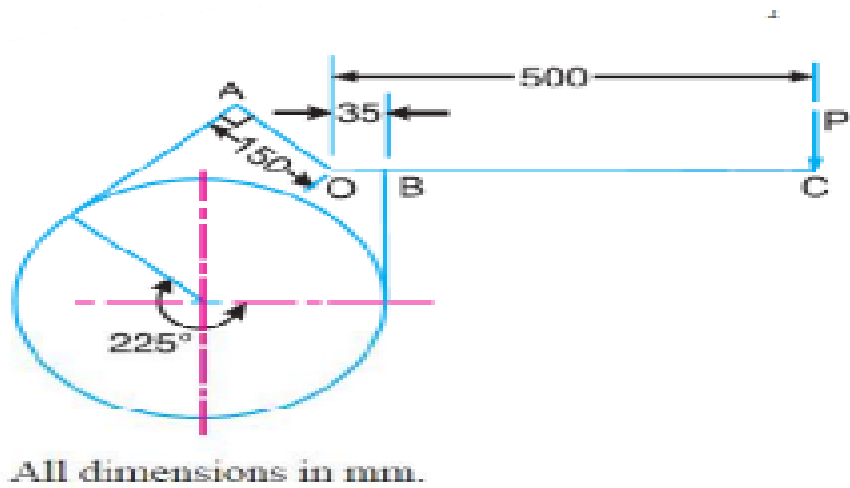
7	What is meant by static and dynamic unbalance in machinery? How can the balancing be done?	2	4	L1
8	Distinguish between longitudinal, transverse, and torsional vibrations	2	4	L1
9	Explain the terms: Piston effort, Crank effort	2	5	L1
10	What is a brake? What is the difference between a brake and a clutch?	2	5	L1
Part-B				
Answer All the following questions.			(10M X 5=50Marks)	
11	The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 r.p.m. clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship: 1. when the ship is steering to the left on a curve of 100 m radius at a speed of 36 km/h. 2. when the ship is pitching in a simple harmonic motion, the bow falling with its maximum velocity. The period of pitching is 40 seconds and the total angular displacement between the two extreme positions of pitching is 12 degrees.	5	1	L4
	OR			
12	An aero plane makes a half circle of 100 m radius towards when flying at 400 kmph. The engine and propeller of plane weigh 500 kg, and have a radius of gyration of 30 cm. The engine rotates at 3000 rpm ccw, when viewed from the front end. Find the gyroscopic couple	5	1	L3
13	The turning moment diagram for a petrol engine is drawn to the following scales : Turning moment, 1 mm = 5 N-m ; crank angle, 1 mm = 1° . The turning moment	5	2	L4

	diagram repeats itself at every half revolution of the engine and the areas above and 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 a radius of gyration of 150 mm. Determine the coefficient of fluctuation of speed when the engine runs at 1800 r.p.m			
	OR			
14	Draw the turning moment diagram of a single cylinder double acting steam engine	5	2	L3
15	Which of the two assumptions, uniform intensity of pressure or uniform rate of wear, will you make use of in designing a friction clutch, and why? Give reason.	5	3	L3
	OR			
16	Sketch an internal expanding shoe brake and derive the expression for friction torque of such a brake	5	3	L3
17	Draw a neat sketch of Proell governor. Establish a relation among the various forces acting on the bent link		4	L3
	OR			
18	The upper and lower ends of the links of a Proell governor are pivoted on the axis of rotation of the governor. Each of the upper and lower links are each 25 cm long between centers, and the lower links carry extension arms each 10 cm long and parallel to the governor axis when the radius of the ball path is 15 cm. Determine the equilibrium speed of the governor for this configuration, if each ball weighs 60 N and the central load weighs 390 N.	5	4	L4
19	Find the frequency of transverse vibrations of a shaft	5	5	L4

	which is simply supported at the ends and is of 40 mm in diameter. The length of the shaft is 5 m. The shaft carries three point loads of masses 15 kg, 35 kg and 22.5 kg at 1 m, 2 m and 3.4 m respectively from the left support. The Young's modulus for the material of the shaft is 200 GN/m ² . The weight of the shaft is 18.394 N per meter length.			
	OR			
20	Describe, with relevant sketches, the Equilibrium method to find the natural frequency of free longitudinal vibrations.	5	5	L3
<div style="display: flex; justify-content: space-between; align-items: flex-start;"> <div style="text-align: center;">  <p>Regulation R-20</p> <p>TKR COLLEGE OF ENGINEERING AND TECHNOLOGY</p> <p>(Autonomous, Accredited by NAAC with 'A' Grade)</p> <p><i>Model Paper</i></p> <p>B.Tech/M.Tech III Year I Semester Regular Examinations, December 2022</p> <p>DYNAMICS OF MACHINERY</p> <p>(MECHANICAL)</p> <p>Maximum Marks: 70</p> </div> <div style="text-align: right;"> <p>Subject code: C35PC1</p> <p>Duration: 3 hours</p> </div> </div>				
<p>Note: 1.This question paper contains two parts A and B.</p> <p>2. Part A is compulsory which carries 20 marks. Answer all questions in Part A.</p> <p>3. Part B consists of 5 Units. Answer any one full question from each unit.</p> <p>4. Each question carries 10 marks and may have a, b, c, d as sub questions.</p>				
Part-A				
All the following questions carry equal marks			(10x2M=20 Marks)	

Q.NO	QUESTIONS	Marks	CO attainment	Blooms Taxonomy Level
1	Write a short note on gyroscope	2	1	L1
2	What do you understand by gyroscopic couple ? Derive a formula for its magnitude	2	1	L1
3	Draw the turning moment diagram of a single cylinder double acting steam engine.	2	2	L1
4	Explain precisely the uses of turning moment diagram of reciprocating engines.	2	2	L1
5	Distinguish between brakes and dynamometers.	2	3	L1
6	Discuss the various types of the brakes.	2	3	L1
7	What is the function of a governor ? How does it differ from that of a flywheel	2	4	L2
8	Define and explain the following terms relating to governors : 1. Stability, 2. Sensitiveness,	2	4	L1
9		2	5	L1
10	Distinguish between longitudinal, transverse, and torsional vibrations.	2	5	L1
Part-B				
Answer All the following questions.			(10M X 5=50Marks)	
11	Explain the effect of Gyroscopic couple on a Naval ship during pitching Draw a neat Sketch ?	5	1	L3
	OR			

12	Explain the effect of Gyroscopic couple on a Aeroplane with a neat Sketch?	5	1	L3
13	The turning moment diagram for a petrol engine is drawn to the following scales : Turning moment, 1 mm = 5 N-m ; crank angle, 1 mm = 1° . The turning moment diagram repeats itself at every half revolution of the engine and the areas above and 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 a radius of gyration of 150 mm. Determine the coefficient of fluctuation of speed when the engine runs at 1800 r.p.m	5	2	L4
	OR			
14	In a turning moment diagram, the areas above and below the mean torque line taken in order are 4400, 1150, 1300, and 4550mm ² respectively. The scales of the turning moment diagram are: Turning moment: 1 mm = 100 N – m; Crank angle: 1mm 10 . Find the mass of the flywheel required to keep the speed between 297 and 303 rpm, if the radius of the gyration is 0.525 m	5	2	L4
15	Explain the uniform pressure theory and uniform wear theory?	5	3	L3
	OR			
16	A differential band brake, as shown in figure, below has an angle of contact of 225° . The band has a compressed woven lining and bears against a cast iron drum of 350 mm diameter. The brake is to sustain a torque of 350 N-m and the coefficient of friction between the band and the drum is 0.3. Find i)The necessary force (P) for the clockwise and anticlockwise rotation of the drum; and ii) The value of ' OA' for the		3	

	<p>brake to be self locking, when the drum rotates clockwise.</p>  <p>All dimensions in mm.</p>			
17	With a neat sketch, explain the working of a Hartnell governor.	5	3	
	OR			
18	Calculate the range of speed of a porter governor which has equal arms of each 200mm long and pivoted on the axis of rotation. The mass of each ball is 4kg and the central load of the sleeve is 20kg. The radius of rotation of the ball is 100mm when the governor being to lift and 130mm when the governor is at maximum speed.	5	4	
19	Explain the Dunkerley's method for finding the frequency of natural transverse vibrations of a simply supported shaft carrying several concentrated loads	5	5	
	OR			
20	A steel shaft 100mm in diameter is loaded and supported in shaft bearing 0.4m apart. The shaft carries three loads: first mass 12kg at the centre, second mass 10kg at a distance 0.12m from the left bearing and third mass of 7kg at a distance 0.09m from the right bearing. Find the value of the critical speed by using Dunker ley's method if $E = 2 \times 10^{11} \text{ N/m}^2$	5	5	



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Part-A

All the following questions carry equal marks **(10x2M=20 Marks)**

Q.NO	QUESTIONS	Marks	CO attainment	Blooms Taxonomy Level
1	Write expression for gyroscopic couple.	2	1	
2	What is the effect of gyroscopic couple on rolling of ship? Why	2	1	
3	What is mean by dynamically equivalent system	2	2	
4	Differentiate between the Turning – moment diagram and Crank-effort diagram? Define the area of turning moment diagram.	2	2	
5	Discuss the effectiveness of a band brake under various conditions?	2	3	

6		2	3	
7	Write short note on 'coefficient of insensitiveness' of governors.	2	4	
8	Define and explain the following terms relating to governors : Isochronism, and . Hunting.	2	4	
9	What is torsionally equivalent shaft?	2	5	
10	Explain briefly, with sketches the longitudinal, transverse and torsional free vibrations	2	5	
Part-B				
Answer All the following questions. (10M X 5=50Marks)				
11	Derive an expression for Gyroscopic effect and draw the Sketch?	5	1	L3
	OR			
12	The rotor of a turbine yacht rotates at 1200rpm clockwise when viewed from stern. The rotor has a mass of 750 kg and radius of gyration of 250mm. Find the maximum gyroscopic couple transmitted to the hull when yacht pitches with a maximum angular velocity of 1 rad/s. What is the effect of this couple?	5	1	L4
13	Draw the turning moment diagram for a single-cylinder double acting steam engine.	5	2	L3
	OR			
14	The length of connecting rod of a gas engine is 500 mm, and its C.G. lies at 165 mm from the crank pin center. The rod has a mass of 80 kg	5	2	L4

	and a radius of gyration of 180 mm about an axis passing through the centre of the mass. The stroke of piston is 225 mm, and the crank speed is 300 rpm. Determine the inertia force on the crankshaft when the crank has turned through 125° from the inner dead centre			
15	In a winch, the rope supports a load W and is wound round a barrel 450 mm diameter. A differential band brake acts on a drum 800 mm diameter which is keyed to the same shaft as the barrel. The two ends of the bands are attached to pins on opposite sides of the fulcrum of the brake lever and at distances of 25 mm and 100 mm from the fulcrum. The angle of lap of the brake band is 250° and the coefficient of friction is 0.25. What is the maximum load W which can be supported by the brake when a force of 750 N is applied to the lever at a distance of 3000 mm from the fulcrum ?	3		L4
	OR			
16	A multi-disc clutch has 5 plates having four pairs of active friction surfaces. If the intensity of pressure is not to exceed 127 kN/m ² , find the power in kW transmitted at 500 rpm, if the outer and inner radii of friction surfaces are 125 mm and 75 mm respectively. Assume uniform wear and take coefficient of friction as 0.3.	3		L4
17	The lengths of the upper and lower arms of a Porter governor are 200mm and 250mm respectively. Both the arms are pivoted on the axis of the rotation. The central load is 150N, the weight of each ball is 20N and the friction of the	4		L4

	sleeve together with the resistance of the operating gears is equivalent to a force of 30N at the sleeve. If the limiting inclinations of the upper arms to the vertical are 30° and 40° , determine the range of speed of the governor			
	OR			
18	What are the functions of a governor? Classify mechanical governors?	5	4	L3
19	Derive the expression for fundamental frequency of a shaft which is simply supported and the shaft carrying a uniformly distributed load	5	5	L3
	OR			
20	A vertical shaft 30 mm diameter and 1m long is mounted in long bearings and carries a pulley of mass 10Kg midway between the bearings. The centre of pulley is 0.5mm from the axis of the shaft. Find i) The whirling Speed and ii) The bending stress in the shaft, when it is rotating at 200 rpm. Take Young's modulus of the material of the shaft as 200 GN/m	5	5	L3



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Part-A

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(10x2M=20 Marks)

Q.NO	QUESTIONS	Marks	CO attainment	Blooms Taxonomy Level
1	Show the set of axes involved in the gyroscopic action?	2	1	L1
2	What is the effect of gyroscopic couple on rolling of ship? Why?	2	1	L1
3	What is meant by turning moment diagram or crank effort diagram	2	2	L1
4	Why flywheels are needed in forging and pressing operations?	2	2	L1
5	What are the functions of Clutch	2	3	L1

6	Why rotating masses are to be dynamically balanced?	2	3	L1
7	What isochronism in governors?	2	4	L1
8	Define dynamic balancing	2	4	L1
9	Write short notes on Denkerly's method	2	5	L1
10	Define frequency, cycle, period and free vibration.	2	5	L1
Part-B				
Answer All the following questions. (10M X 5=50Marks)				
11	Find the angle of inclination with respect to the vertical of a two wheeler negotiating a turn. Given : combined mass of the vehicle with its rider 250 kg ; moment of inertia of the engine flywheel 0.3 kg-m ² ; moment of inertia of each road wheel 1 kg-m ² ; speed of engine flywheel 5 times that of road wheels and in the same direction ; height of centre of gravity of rider with vehicle 0.6 m ; two wheeler speed 90 km/h ; wheel radius 300 mm ; radius of turn 50 m.	5	1	L4
	OR			
12	An aeroplane runs at 600 km / h. The rotor of the engine weighs 4000 N with radius of gyration of 1 metre. The speed of rotor is 3000 r.p.m. in anticlockwise direction when seen from rear side of the aeroplane. If the plane takes a loop upwards in a curve of 100 metres radius, find : 1. gyroscopic couple developed; and 2. effect of reaction gyroscopic couple developed on the	5	1	L4

	body of aerop			
13	<i>; A horizontal cross compound steam engine develops 300 k W at 90 r.p.m. The coefficient of fluctuation of energy as found from the turning moment diagram is to be 0.1 and the fluctuation of speed is to be kept within $\pm 0.5\%$ of the mean speed. Find the weight of the flywheel required, if the radius of gyration is 2 metres.</i>	5	2	L4
	OR			
14	<i>Draw the turning moment diagram of a single cylinder double acting steam engine</i>	5	2	L3
15	<i>Which of the two assumptions, uniform intensity of pressure or uniform rate of wear, will you make use of in designing a friction clutch, and why? Give reason.</i>	5	3	L3
	OR			

16	A band and block brake, having 14 blocks each of 5 which subtends an angle of 15° at the centre, is applied to a drum of 1 m effective diameter. The drum and flywheel mounted on the same shaft has a mass of 2000 kg and a combined radius of gyration of 500 mm. The two ends of the band are attached to pins on opposite sides of the brake lever at distances of 30 mm and 120 mm from the fulcrum. If a force of 200 N is applied at a distance of 750 mm from the fulcrum, find: 1. maximum braking torque, 2. angular retardation of the drum, and 3. time taken by the system to come to rest from the rated speed of 360 r.p.m. The coefficient of friction between blocks and drum may be taken as 0.25	5	3	L4
17	Four masses A, B, C and D revolves at equal radii and equally spaced along a shaft. The mass B is 7kg and the radii of C and D make angle s of 90° and 240° respectively with the radius of B. Find the Magnitude of masses A, C and D and angular position of A, so that the system may be completely balanced		4	L4
	OR			
18	A Porter governor has equal arms 200 mm long 5 pivoted on the axis of rotation. The mass of each ball is 3 kg and the mass on the sleeve is 15 kg. The ball path is 120 mm when the governor begins to lift and 160 mm at the maximum speed. Determine the range of speed. If the friction at the sleeve is equivalent to a force of 10N, find the coefficient of insensitiveness.	5	4	L4
19	Distinguish the longitudinal, transverse and 5		5	L3

	torsional free vibrations.			
	OR			
20	A cantilever shaft 50mm diameter and 300mm long has a disc of mass 100kg at its free end. The Young' s modulus for the shaft material is 200GN/m ² . Determine the frequency of longitudinal and transverse vibration of the shaft.	5	5	L3