QP Code: RN22BTECH241 | Reg. No | | | | | | | | | | | AR 22

Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
(GIET University)

B. Tech (Fifth Semester - Regular) Examinations, November – 2024

22BMEPC35001 – Dynamics of Machinery

(Mechanical Engineering)

Time: 3 hrs | Maximum: 70 Marks

Answer ALL questions

(The figures in the right hand margin indicate marks)

PART – A **(2 x 5 = 10 Marks)**

Q.1. Answer ***ALL*** questions	CO #	Blooms Level
a. Explain why two Hooke's joints are used to transmit motion from the engine to the differential of an automobile.	CO1	K1
b. Describe the effect of gyroscopic couple on aeroplane.	CO2	K2
c. State the requirement of multi-collar bearing.	CO3	K2
d. Calculate the vertical height of a Watt governor when it rotates at 60 rpm. Also find the change in vertical height when its speed increases to 61 rpm.	CO2	K2
e. State the condition for achieving dynamic balancing.	CO4	K1

PART – B **(15 x 4 = 60 Marks)**

Answer ***All*** the questions	Marks	CO #	Blooms Level
2. a. The turning moment diagram for a multicylinder engine has been drawn to a scale 1 mm = 600 N-m vertically and 1 mm = 3° horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows: + 52, – 124, + 92, – 140, + 85, – 72 and + 107 mm2, 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, find the necessary mass of the flywheel of radius 0.5 m.	10	CO1	K3
b. The mass of flywheel of an engine is 5.5 tonnes and the radius of gyration is 2m. It is found from turning moment diagram that fluctuation of energy is 47kNm. If the mean speed of the engine is 120 rpm. Find the maximum and minimum speed.	5	CO1	K3
(OR)			
c. A vertical double acting steam engine has a cylinder 300 mm diameter and 450 mm stroke and runs at 200 rpm. The reciprocating parts has a mass of 225 kg and the piston rod is 50 mm diameter. The connecting rod is 1.2 m long. When the crank has turned through 125° from the top dead centre, the steam pressure above the piston is 30 kN/m^2 and below the piston is 1.5 kN/m^2. Calculate the effective turning moment on the crank shaft and thrust on crank bearing.	10	CO1	K3
d. Two shafts with an included angle of 160° are connected by a Hooke's joint. The driving shaft runs at a uniform speed of 1500 rpm. The driven shaft carries a flywheel of mass 12 kg and 100 mm radius of gyration. Find the maximum angular acceleration of the driven shaft and the maximum torque required.	5	CO1	K3
3.a. Each arm of a Porter governor is 250 mm long. The upper and lower ends of the arms are pivoted to link of 40 mm and 50 mm respectively from the axis of	10	CO2	K3

rotation. Each ball has a mass of 6 kg and the sleeve mass is 60 kg. The force of friction on the sleeve of the mechanism is 40 N. Determine the range of speed of governor for extreme radii of rotation of 125 mm and 150 mm.

b. A uniform disc of diameter 300 mm and of mass 5 kg is mounted on one end of an arm of length 600 mm. The other end of the arm is free to rotate in a universal bearing. If the disc rotates about the arm with a speed of 300 rpm. clockwise, looking from the front, with what speed will it process about the vertical axis? 5 CO2 K3

(OR)

c. 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: 10 CO2 K3

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.

d. A Proell governor has equal arms of length 300 mm. The upper and lower ends of the arms are pivoted on the axis of the governor. The extension arms of the lower links are each 80 mm long and parallel to the axis when the radii of rotation of the balls are 150 mm and 200 mm. The mass of each ball is 10 kg and the mass of the central load is 100 kg. Determine the range of speed of the governor. 5 CO2 K3

4.a. A plate clutch has three discs on the driving shaft and two discs on the driven shaft, providing four pairs of contact surfaces. The outside diameter of the contact surfaces is 240 mm and inside diameter 120 mm. Assuming uniform pressure and μ= 0.3; find the total spring load pressing the plates together to transmit 25 kW at 1575 rpm. If there are 6 springs each of stiffness 13 kN/m and each of the contact surfaces has worn away by 1.25 mm, find the maximum power that can be transmitted, assuming uniform wear. 10 CO3 K3

b. A conical friction clutch is used to transmit 90 kW at 1500 rpm. The semicone angle is 20º and the coefficient of friction is 0.2. If the mean diameter of the bearing surface is 375 mm and the intensity of normal pressure is not to exceed 0.25 N/mm^2, find the dimensions of the conical bearing surface and the axial load required. 5 CO3 K3

(OR)

c. A thrust shaft of a ship has 6 collars of 600 mm external diameter and 300 mm internal diameter. The total thrust from the propeller is 100 kN. If the coefficient of friction is 0.12 and speed of the engine 90 rpm., find the power absorbed in friction at the thrust block, assuming **l.** Uniform pressure ; and **2.** Uniform wear. 5 CO3 K3

d. A band and block brake, having 14 blocks each of 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 10 CO3 K3

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

The coefficient of friction between blocks and drum may be taken as 0.25.

5.a.	Four masses A, B, C and D are attached to a shaft and revolve in the same plane. The masses are 6 kg, 5 kg, 9 kg and 7 kg respectively and their radii of rotations are 40 mm, 50 mm, 60 mm and 34 mm. The angular position of the masses B, C and D are 60°, 150° and 240° from the mass A. Find the magnitude and position of the balancing mass at a radius of 100 mm.	8	CO4	K3
b.	The following data are given for a vibrating system with viscous damping: Mass: 2.5 kg, Spring Constant: 3N/mm, Amplitude decreases to 0.25 of the initial values after five consecutive cycles. Determine the damping coefficient of the damper in the system.	7	CO4	K3
	(OR)			
c.	A mass of 7.5 kg hangs from a spring and makes damped oscillations. The time for 60 oscillations is 35 seconds and the ratio of the first and seventh displacement is 2.5. Calculate i) stiffness of the spring ii) damping factor iii) logarithm decrement.	7	CO4	K3
d.	A, B, C and D are four masses carried by a rotating shaft at radii 100 mm, 150 mm, 150 mm and 200 mm respectively. The planes in which the masses rotate are spaced at 500 mm apart and the magnitude of the masses B, C and D are 9 kg, 5 kg and 4 kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance	8	CO4	K3

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