Code No: 134AU **R16**

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B.Tech II Year II Semester Examinations, December - 2019
DYNAMICS OF MACHINERY
(Mechanical Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b, c as sub questions.

PART- A

(25 Marks)

1.a) What is rolling motion of a ship? What is the gyroscopic effect on ships during rolling? Why? [2]
b) State the condition for static equilibrium of a three-force body. [3]
c) Define the coefficient of fluctuation of speed. [2]
d) What is meant by equivalent dynamical system? Write down the conditions to determine the equivalent dynamical system [3]
e) Why uniform wear assumption is preferred while designing a clutch? [2]
f) What is self locking in brakes? Explain with an example. [3]
g) Why secondary unbalanced forces are not considered in balancing of single cylinder reciprocating engines? [2]
h) Define sensitivity and isochronism of governors. [3]
i) Write down the Dunkerley's formula to find natural frequency of a beam with several point loads. Also mention the limitation of the formula. [2]
j) What is node on a shaft with rotors? How many nodes lie on the shaft with three rotors? Draw the mode shape diagrams. [3]

PART-B

(50 Marks)

2. The moment of inertia of a pair of locomotive driving wheels with the axle is 200 kg.m^2. The distance between the wheel centres is 1.6 m and the diameter of the wheel treads is 1.8 m. Due to defective ballasting, one wheel falls by 5 mm and rises again in a total time of 0.12 seconds while the locomotive travels on a level track at 120 km/h. Assuming that the displacement of the wheel takes place with simple harmonic motion, determine the gyroscopic couple produced and the reaction between the wheel and rail due to this couple. [10]

OR

3. Determine the couple T_2 acting on the link 2 to maintain the static equilibrium of the slider crank mechanism subjected to forces as shown in Figure 1. The link lengths are AB=300mm, BC=455mm, BE=175mm. [10]

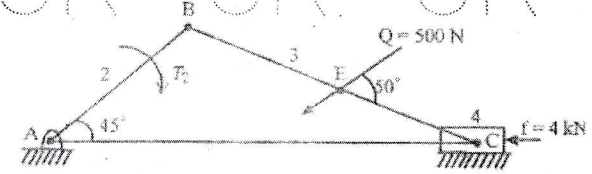

Figure: 1

4. The crank-pin circle radius of a horizontal engine is 300 mm. The mass of the reciprocating parts is 250 kg. When the crank has travelled 60^0 from I.D.C., the difference between the driving and the back pressures is 0.35 N/mm^2. The connecting rod length between centres is 2 m and the cylinder bore is 600mm. If the engine runs at 300 r.p.m. and if the effect of piston rod diameter is neglected, calculate: a) thrust on side walls of the cylinder, b) thrust in the connecting rod, c) tangential force on the crank-pin, d) turning moment on the crank shaft and e) Thrust on main bearings of the crank shaft. [10]

OR

5. The turning-moment diagram of a four-stroke engine is assumed to be represented by four triangles, the areas of which from the line of zero pressure are
Suction stroke = 440 mm^2 (Below zero line)
Compression stroke = 1600 mm^2 (Below zero line)
Expansion stroke = 7200 mm^2 (above zero line)
Exhaust stroke = 660 mm^2 (Below zero line)
Each mm^2 of area represents 3 N.m of energy. If the resisting torque is uniform, determine the mass of the rim of a flywheel to keep the speed between 218 and 222 rpm when the mean radius of the rim is to be 1.25 m. [10]

6. The shaft of a collar thrust bearing rotates at 200 rpm and carries an end thrust of 100kN. The outer and the inner diameters of the bearing are 480 mm and 280 mm respectively. If the power lost in friction is not to exceed 8 kW, determine the coefficient of friction of the lubricant of the bearing. [10]

OR

7. A motor runs at 1200 rpm is fitted with a brake drum of diameter 500mm. The spring balance readings are 150N and 80N. The diameter of the rope is 25mm. Find the torque on the motor and power of the motor. [10]

8. The mass of each ball of a Proell governor is 7.5 kg and the load on the sleeve is 80 kg. Each of the arms is 300 mm long. The upper arms are pivoted on the axis of rotation whereas the lower arms are pivoted to links of 40 mm from the axis of rotation. The extensions of the lower arms to which the balls are attached are 100 mm long and are parallel to the governor axis at the minimum radius. Determine the equilibrium speeds corresponding to extreme radii of 180 mm and 240 mm. [10]

OR

9. 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. [10]

10. A shaft 50 mm diameter and 3m long is simply supported at the ends and carries three loads of 1000 N, 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. Find the natural frequency of transverse vibration of the shaft. [10]

OR

11. A torsional system is shown in Figure 2. Find the frequencies of torsional vibrations and the positions of the nodes. G = 84×10^9 N/m^2. [10]

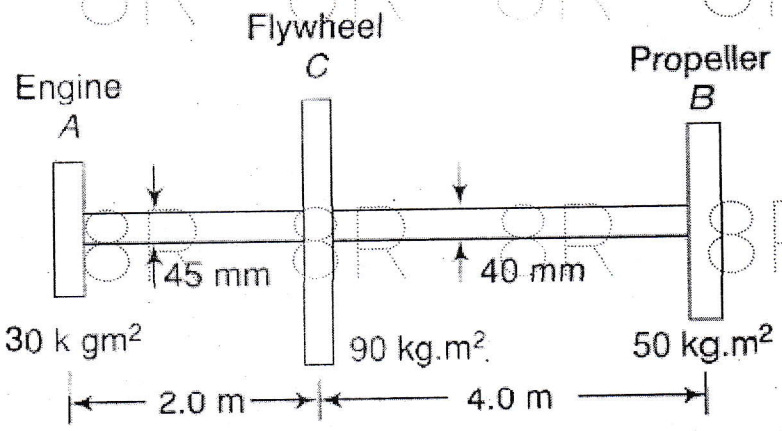

Figure: 2

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