Registration No.: | | | | | | | | | | |

Total Number of Pages: 03 **Course: B.Tech**

Sub_Code: RAU4C001 / RME4C001

4th Semester Back Examination: 2024-25

SUBJECT: KINEMATICS & DYNAMICS OF MACHINES

BRANCH(S): AUTO,MECH, MMEAM

Time: 3 Hours

Max Marks: 100

Q.Code: S439

Answer Question No.1 (Part-I) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) Differentiate between Turning pair and sliding pair.

b) Differentiate between completely constrained motion and incompletely constrained motion.

c) What are the methods for determining the velocity of a point on a link?

d) A slider sliding at 10 cm/s on a link, which is rotating at 60 rpm, is subjected to Coriolis acceleration of magnitude? Find it.

e) In a screw jack, the helix angle of thread is 'α' and friction angle is 'Ø'. Show that its efficiency is maximum when $2\alpha = (90^0 - \emptyset)$.

f) Define slip of the belt.

g) What are the different types of mechanical brakes.

h) Explain the terms I) Module II) Addendum

i) Write down the difference between simple gear train and compound gear train.

j) State D-Alembert's Principle.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) With the help of a neat sketch explain the working of a reverted gear train. Give at least two applications of the same.

b) What is the difference between piston effort, crank effort, and crank-pin effort?

c) Sketch and describe the four bar chain mechanism. Why it is considered to be the basic chain?

d) Obtain the conditions for the maximum power transmitted by a belt from one pulley to another.

e) Describe with help of a neat sketch the construction and working of a rope brake absorption dynamometer.

f) With a neat sketch, describe a single shoe brake. What is the advantage of double shoe brake over single shoe brake.

g) Prove that the torque transmitted by a cone clutch when intensity of pressure is uniform, is given by $T = \frac{2\mu W}{3sin\alpha}\left(\frac{r_1{}^3 - r_2{}^3}{r_1{}^2 - r_2{}^2}\right)$, Where W = Axial Load, α = Semo Cone-angle, μ = Co-efficient of friction, r_1 = Maximum Radius, r_2 = Minimum radius of contact surface

h) If interference between two involute gears is to be avoided then prove that the maximum length of arc of contact will be equal to (r + R) tanØ, where r = pitch circle radius of pinion R = Pitch circle radius of wheel and Ø = Pressure angle.

i) Derive an expression for the effort required to raise a load with a screw jack taking friction into consideration.

j) Write short notes on Coriolis acceleration component.

k) Derive an expression for the length of a belt in a cross belt drive.

l) Prove that the correction couple (T_c) is given by $T_c = m \times L_1 \times (I - L) \times \alpha$
Where m = mass of rigid body, L_1 = Distance of mass m_1 from the C.G of the body
L = Distance between two masses m_1 and m_2 which form a true dynamically equivalent system
I = Distance between two masses which are placed arbitrarily
α = Angular acceleration of the rigid body

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four) **(16 x 2)**

Q3 Show that, in a band and block brake, the ratio of the maximum and minimum tensions in the brake straps is **(16)**

$$\frac{T_0}{T_n} = \left(\frac{1+\mu\tan\theta}{1-\mu\tan\theta}\right)^n$$

Where,
$T_0 =$ Maximum Tension
$T_n =$ Minimum Tension
$\mu =$ Coefficient of friction between the blocks and drum
$2\theta =$ Angle subtended by each block at the centre of the drum

Q4 **a)** For a flat belt drive prove that **(10)**

$$\frac{T_1}{T_2} = e^{\mu\theta}$$

Where T_1 = Tension on the tight side of the belt
T_2 = Tension on the slack side of the belt
μ = Co-efficient of friction between the belt and pulley surface
θ = Angle of contact between the belt and the pulley

b) Determine the maximum power that can be transmitted using a belt of 100 mm × 10 mm with an angle of lap 160^0. The density of the belt is 10^{-3} gm/mm^3 and co-efficient of friction may be taken as 0.25. The tension in the belt should not exceed 1.5 N/mm^2. **(6)**

Q5 How are velocity and acceleration of the slider of a single slider crank chain determined analytically? Derive analytically angular velocity and angular acceleration of the connecting rod. **(16)**

Q6 Figure shows an epicyclic gear train. Pinion A has 15 teeth and is rigidly fixed to the motor shaft. The wheel B has 20 teeth and gears with A and also with the annular fixed wheel E. Pinion C has 15 teeth and is integral with B (B, C being a compound gear wheel). Gear C meshes with annular wheel D, which is keyed to the machine shaft. The arm rotates about the same shaft on which A is fixed and carries the compound wheel B, C. If the motor runs at 1000 rpm., find the speed of the machine shaft. **(16)**