JAYA GROUP OF INSTITUTION-THIRUNINRAVUR
4th SEM – B.E. / B.Tech
INTERNAL ASSESSMENT-3(MODEL EXAM-III)

Sub. Name: Mechanics of Machines
Sub. Code: AT6302
Duration: 180 minutes

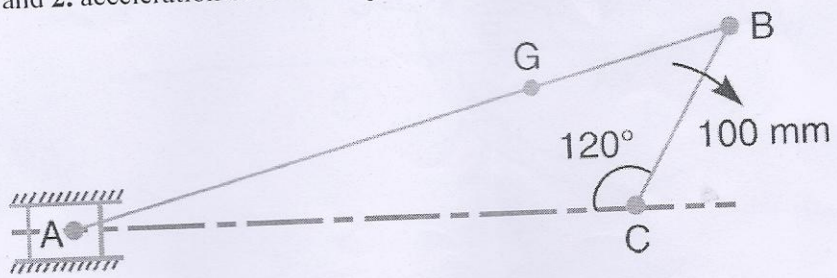
Date:06/04 /2015
Branch: Aeronautical
Max.Marks: 100

Part A **10X2=20**

1. Classify constrained motion. Define binary and tertiary joint
2. Define tangent and circular arc cam
3. How the velocity ratio of an epicyclic gear train is obtained by tabular method?
4. State the law of gearing and methods to avoid interference?
5. (i) State the laws of friction (ii) Define limiting angle of friction and angle of repose
6. Define self locking and self energizing brakes
7. State the D-Alembert's principle and significance of inertia force analysis?
8. What are the condition for a body to be in equilibrium under the action of (a) two force member and (b) two force and torque ?
9. Define (a) whirling speed (b) isolation factor
10. What do you mean by primary and secondary balancing in balancing of reciprocating masses?

Part B **5X16=80**

11 (a) An engine mechanism is shown in below Fig.The crank CB = 100 mm and the connecting rod BA = 300 mm with centre of gravity G, 100 mm from B. In the position shown, the crankshaft has a speed of 75 rad/s and an angular acceleration of 1200 rad/s2. Find:**1.** Velocity of G and angular velocity of AB, and **2.** acceleration of G and angular acceleration of AB. (16)



OR

11 (b) A cam rotating clockwise at a uniform speed of 1000 r.p.m. is required to give a roller follower the motion defined below: **1.** Follower to move outwards through 50 mm during 120° of cam rotation, **2.** Follower to dwell for next 60° of cam rotation, **3.** Follower to return to its starting position during next 90° of cam rotation, **4.** Follower to dwell for the rest of the cam rotation. The minimum radius of the cam is 50 mm and the diameter of roller is 10 mm. The line of stroke of the follower is off-set by 20 mm from the axis of the cam shaft. If the displacement of the follower takes place with uniform and equal acceleration and retardation on both the outward and return strokes, draw profile of the cam and find the maximum velocity and acceleration during out stroke and return stroke. (16)

12(a) (i) Two 20 involute spur gears have a module of 10mm. The addendum is one module. The larger gear has 50 teeth and the pinion has 13 teeth. Does interference occur. If it occurs, to what value should the pressure angle be changed to eliminate interference (6)

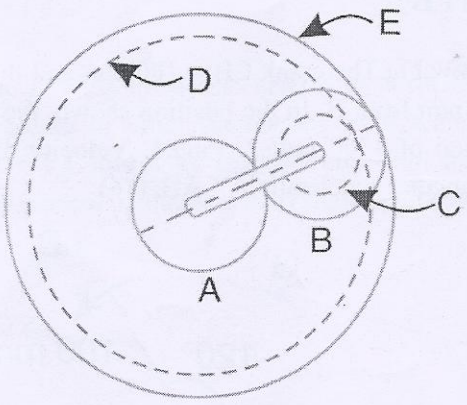
(ii) Derive an expression to determine the length of path of contact between two spur gears(6)

(iii) Show that the involute curves as the profile of mating gears satisfy the law of gearing (4)

OR

12(b)(i) Briefly explain the sub classification of compound gear train with neat sketches (4)

(ii) Below fig 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 r.p.m., find the speed of the machine shaft. Find the torque exerted on the machine shaft, if the motor develops a torque of 100 N-m. (12)



13 (a) (i) The mean diameter of the screw jack having pitch of 10 mm is 50 mm. A load of 20 kN is lifted through a distance of 170 mm. Find the work done in lifting the load and efficiency of the screw jack when **1.** The load rotates with the screw, and **2.** the load rests on the loose head which does not rotate with the screw. The external and internal diameter of the bearing surface of the loose head are 60 mm and 10 mm respectively. The coefficient of friction for the screw as well as the bearing surface may be taken as 0.08. (8)

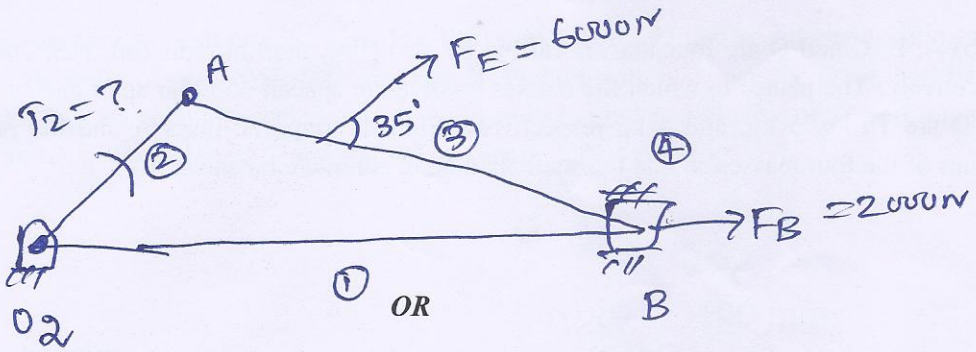
13 (a)(ii)The external and internal radii of a friction clutch of disc type are 90mm and 50mm respectively .Both sides of the clutch are effective and co efficient of friction is equal to 0.25.The friction clutch is used to rotate the machine from a shaft which is rotating at a constant speed of 250r.p.m. The moment of inertia of the rotating parts of the machine is 5.5kgm2.The intensity of pressure is not to exceed 0.8*105N /m2 .A assuming uniform wear, determine the time required for the machine to attain the full speed when the clutch is suddenly applied. Also determine the energy lost in slipping of the clutch (8)

OR

13 (b) (i)An open belt running over two pulleys 240 mm and 600 mm diameter connects two parallel shafts 3 meters apart and transmits 4 kW from the smaller pulley that rotates at 300 r.p.m. Coefficient of friction between the belt and the pulley is 0.3 and the safe working tension is 10N per mm width. Determine: **1.** minimum width of the belt, **2.** initial belt tension, and **3.** length of the belt required. (8)

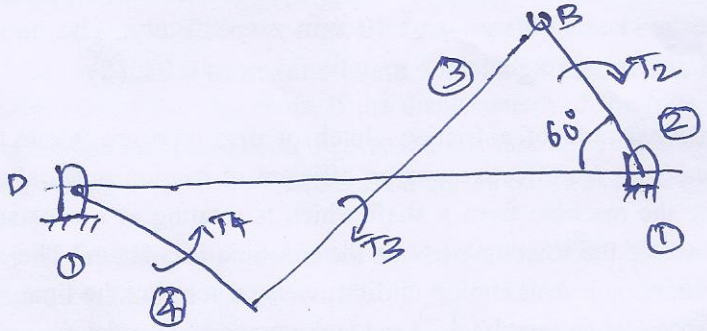
(ii) Following data is given for a rope pulley transmitting 24 kW : Diameter of pulley = 400 mm ; Speed = 110 r.p.m.; angle of groove = 45° ; Angle of lap on smaller pulley = 160° ; Coefficient of friction = 0.28 ; Number of ropes = 10 ; Mass in kg/m length of ropes = $53C^2$; and working tension is limited to $122C^2$ kN, where C is girth of rope in metres. Find initial tension and diameter of each rope (8)

14 (a) Determine the torque T_2 to keep the body in equilibrium. The length of the links are O_2A=100mm, AB=250mm, AE=50mm, AO_2B=30° (16)



OR

14 (b) In a four link mechanism shown in below fig. The torques T_2 and T_4 have magnitudes of 30N-m and 20N-m respectively. The link lengths are AD=800mm, AB=300 mm, BC=700mm and CD=400mm. For the static equilibrium of the mechanism, determine the input torque T_2 (16)



15(a) (i) A machine has a mass of 100 kg and unbalanced reciprocating parts of mass 2 kg which move through a vertical stroke of 80 mm with simple harmonic motion. The machine is mounted on four springs, symmetrically arranged with respect to centre of mass, in such a way that the machine has one degree of freedom and can undergo vertical displacements only. Neglecting damping, calculate the combined stiffness of the spring in order that the force transmitted to the foundation is 1 / 25 th of the applied force, when the speed of rotation of machine crank shaft is 1000 r.p.m. When the machine is actually supported on the springs, it is found that the damping reduces the amplitude of successive free vibrations by 25%. Find : **1.** the force transmitted to foundation at 1000 r.p.m., **2.** the force transmitted to the foundation at resonance, and **3.** the amplitude of the forced vibration of the machine at resonance. (8)

(ii) A vertical steel shaft 15 mm diameter is held in long bearings 1 metre apart and carries at its middle a disc of mass 15 kg. The eccentricity of the centre of gravity of the disc from the centre of the rotor is 0.30 mm.The modulus of elasticity for the shaft material is 200 GN/m2 and the permissible stress is 70 MN/m2. Determine: **1.** The critical speed of the shaft and **2.** The range of speed over which it is unsafe to run the shaft. Neglect the mass of the shaft.(8)

OR

15 (b) 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. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance.(16)