INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad - 500 043

AERONAUTICAL ENGINEERING

ASSIGNMENT

Course Name	:	**MECHANISMS AND MACHANICAL DESIGN**
Course Code	:	**A72123**
Class	:	IV-I Semester B.Tech
Branch	:	Aeronautical Engineering
Year	:	2017 – 2018
Course Coordinator	:	Mr B.Naveen kumar Assistant Professor

OBJECTIVES

This course introduces the basic concepts underlying in performing experiments in aerodynamics which is the foundation for aerodynamics in the field Aeronautical Engineering. The emphasis of this course is laid on understanding the concepts of similarity, errors in experimentation, design of experimental facility, physics and instrumentation used for measurement of parameters like pressure, velocity, temperature and fundamentals of flow visualization techniques

S. No	Question	Blooms Taxonomy Level	Course Outcome
	ASSIGNMENT-I **UNIT-I** **MECHANISMS**		
1	a) Define link and kinematic pair. b) Enumerate the inversions of double slider crank chain mechanism.	Remember	1
2	a) Define machine and mechanism. b) Enumerate the inversions of single slider crank chain mechanism	Analyze	1
3	a) Explain the quick return motion mechanism of crank and slotted lever. b) The length of the fixed link in a crank and slotted lever quick return mechanism is 300 mm and crank is 110 mm. Determine the inclination of the slotted lever with the vertical in the extreme position.	Evaluate	2
4	Explain the Whitworth quick return motion mechanism .	Remember	2
5	In a Whitworth quick return motion mechanism, the distance between the fixed centers is 50 mm and the length of the driving crank is 75 mm. The length of the slotted lever is 150 mm and the length of the connecting rod is 135 mm. Find the ratio of time of cutting and return strokes and also the effective stroke.	Understand	2
6	A crank and slotted lever mechanism used in a shaper has a centre distance of300 mm between the centre of oscillation of the slotted lever and the centre of rotation of the crank. The radius of the crank is 120 mm. Find the ratio of the time of cutting to the time of return stroke.	Analyze	2
7	In a crank and slotted lever quick return motion mechanism, the distance between the fixed centres is 240 mm and the length of the driving crank is 120 mm. Find the inclination of the slotted bar with the vertical in the extreme position and the time ratio of cutting stroke to the return stroke. If the length of the slotted bar is 450 mm, find the	Evaluate	2

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	length of the stroke if the line of stroke passes through the extreme positions of the free end of the lever.		
8	The Whitworth quick return motion mechanism has the driving crank 150 mm long. The distance between fixed centres is 100 mm. The line of stroke of the ram passes through the centre of rotation of the slotted lever whose free end is connected to the ram by a connecting link. Find the ratio of time of cutting to time of return.	Evaluate	2
9	In a crank and slotted lever quick return mechanism, the distance between the fixed centres is 150 mm and the driving crank is 75 mm long. Determine the ratio of the time taken on the cutting and return strokes.	Evaluate	2
10			
	UNIT- II **KINEMATIC ANALYSIS AND DESIGN OF MECHANISMS**		
1	a) Mention different types of instantaneous centres. b) Locate the instantaneous centres for crank and slotted lever quick return mechanism.	Understand	3
2	a) Define Instantaneous centre b) Locate all the Instantaneous centers of slider crank mechanism with crank length of 25mm rotating clockwise at a uniform speed of 100 rpm. The crank makes 45^0 with IDC and the connecting rod is 400 mm long .Determine the velocity of the slider and the angular velocity of connecting rod?	Analyze	4
3	a) State and explain the Kennedy's theorem.. b) In a slider crank mechanism, the crank OA makes 400 rpm in the counter clockwise direction which is 60^0 from IDC. The lengths of the links are OA= 60 mm, OB= 220 mm and BA= 280 mm. Determine the velocity and acceleration of the sliderB?	Analyze	4
4	a)Explain Klien's construction for determining velocity and acceleration of slider crank mechanism. b) Explain the method of determining the Coriolis component of acceleration in crank and slotted lever quick return mechanism?	Understand	4
5	Determine the velocity and acceleration of the link QR and RS in a four bar mechanism in which PQRS is a four bar mechanism with fixed link PS. Crank PQ rotates uniformely and makes an angle of 60^0 with PS in anti clockwise direction.. The length of the links are PQ=62.5 mm, QR= 175 mm, RS= 112.5 mm and PS= 200 mm. Crank PQ rotates at 10 radians/ second?	Understand	3
6	The Crank of a slider crank mechanisms rotates clockwise at a Constant speed of 600 r.p.m. The crank is 125 mm and connecting rod is 500 mm long. Determine 1. Linear velocity and acceleration of the mid Point of the connecting rod, and 2. Angular velocity and angular acceleration of the connecting rod, at a crank angle of 45° from inner dead centre position.		
7	In a four link mechanism, the dimensions of the links are AB=200 mm, BC=400mm,CD=450 mm and AD=600mm. At the instant when DAB=90°, the link AB has angular velocity of 36 rad/s in the clockwise direction. Determine(i) The velocity of point C, (ii) The velocity of point E on the link BC When BE=200 mm (iii) the angular velocities of links BC and CD, iv) acceleration	Evaluate	4

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	of link of link BC.		
8	The dimensions of the various links of a mechanism, as shown in fig. are as follows: OA=300 mm;AB=1200; BC=450 mm and CD=450 mm. if the crank OA rotates at 20 r.p.m. in the anticlockwise direction and gives motion to the sliding blocks B and D, find, for given configuration: (1) Velocity of sliding at B and D, (2) Angular velocity of CD (3) Linear acceleration of D and (4) angular acceleration of CD.	Evaluate	4
9	a)Derive the expressions for Velocity and acceleration of piston in reciprocating steam engine mechanism with neat sketch b).Derive the expression for Coriolis component of acceleration with neat sketch.	Evaluate	4
10	In a slider crank mechanism, the length of the crank and the connecting rod are100 mm and 400 mm respectively. The crank position is 45° from IDC, the crank shaft speed is 600 r.p.m. clockwise. Using analytical method Determine(1)Velocity and acceleration of the slider, and (2) Angular velocity and angular acceleration of the connecting rod.	Evaluate	4
	UNIT-III **GYROSCOPE-PRECESSIONAL MOTION**		
1	The turbine rotor of a ship has a mass of 20 tones & a radius of gyration of 0.75m.Its speed is 2000 rpm.the ship pitches 6degrees above & below the horizontal position. One complete oscillation takes 18 sec & the motion is simple harmonic. Determine (i)The maximum couple tending to shear the holding down bolts of the turbine. (ii)The maximum angular acceleration of the ship during pitching & (iii)The direction in which the bow will tend to turn while rising, if the rotation the rotor is clock wise when looking from rear	Understand	5
2	In a slider crank mechanism, the lengths of the crank and the connecting rod are 480 mm and 1.6 m respectively. It has an eccentricity of 100 mm. Assuming a velocity of 20 rad/sec of the crank OA. Calculate the following at an interval of 30 degrees. i). Velocity and the acceleration of the slider ii). Angular velocity and angular acceleration of the connecting rod.	Remember	5
3	A car weighs 20KN. It has a wheel base of 2m, Track width 1m & Height of C.G. 300 mm above the ground level & lies midway between the front & rear axle. The engine flywheel rotates at 3000 rpm clockwise when viewed from the front. The moment of inertia of the fly wheel is 4kg-m^2 & MOI of each wheel is 3 kg-m^2, find the reactions between the wheels & the ground when car takes the curve of 15m radius towards right at 30 km/hr, taking into consideration the gyroscopic & the centrifugal effects. Each wheel radius is 400mm	Remember	6
4	In a Four-link mechanism, the dimensions of the links are: AB=20 mm, BC= 66mm, CD= 56 mm, and AD = 80 mm. AD is the fixed link. The crank rotates at uniform angular velocity of 10.5 rad/sec in the counter-clockwise direction Determine the angular displacements, angular velocities angular accelarations of the output link DC and the coupler BC for a complete revolution of the crank at an interval of 40 degrees	Understand	6

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5	Determine the required input torque on the crank of a slider-crank mechanism for the static equilibrium when the applied piston load is 1500N. the lengths of the crank and the connecting rod are 40mm and 100 mm respectively, and the crank has turned through 450 from the inner dead centre	Evaluate	6
	ASSIGNMENT – II **UNIT-III** **BEAMS AND COLUMS**		
1	The rotor of the turbine of a yacht makes 1200 rpm clockwise when viewed from the stern. The rotor has a mass of 750 kg, and its radius of gyration is 250 mm. Find the maximum gyroscopic couple transmitted to the hull (body of the yacht), when the yacht pitches with maximum angular velocity of 1 rad/s.	Evaluate	6
2	An aeroplane makes a complete half circle of 50 meters radius, towards left, when flying at 200 kmph. The rotary engine and the propeller of the plane has a mass of 400 kg. and a radius of gyration of 0.3 m. The engine rotates at 2400 r.p.m. clockwise when viewed from the rear. Find the gyroscopic couple on the aircraft and state its effect on it.	Evaluate	6
3	A four wheeled motor car of mass 2000 kg has a wheel base 2.5 m, track width 1.5 m and height of center of gravity 500 mm above the ground level and lies at 1 meter from the front axle. Each wheel has an an effective diameter of 0.8 m and a moment of inertia of 0.8 kg-m2. The drive shaft, Engine flywheel and transmission are rotating at 4 times the speed of road wheel, in a clockwise direction when viewed from the front, and is equivalent to a mass of 75 kg having a radius of gyration of 100 mm. If the car is taking a right turn of 60 m radius at 60 km/h, find the load on each wheel	Evaluate	6
4	The moment of inertia of an aeroplane air screw is 20 kg-m2 and the speed of rotation is 1000 rpm clockwise when viewed from the front. The speed of the flight is 200 kmph.Find the gyroscopic reaction of the air screw on the aeroplane when it makes a lefthanded turn on a path of 150 m radius	Evaluate	6
5	The turbine rotor of a ship has a mass of 20 tones & a radius of gyration of 0.75m.Its speed is 2000 rpm.the ship pitches 6degrees above & below the horizontal position. One complete oscillation takes 18 sec & the motion is simple harmonic. Determine (i)The maximum couple tending to shear the holding down bolts of the turbine. (ii)The maximum angular acceleration of the ship during pitching & (iii)The direction in which the bow will tend to turn while rising, if the rotation the rotor is clock wise when looking from rear	Evaluate	6
	UNIT-IV **CAMS AND FOLLOWERS**		
1	a) Define a cam and mention the types? b) What are the various motions possible with cam and follower?		7
2	a) Define a follower and mention the types? b) Draw and explain the displacement and velocity diagrams for uniform velocity motion.	Understand	8
3	a) Define the following terms as applied to cams with neat sketch: i) Base circle ii) pitch circle iii) pressure angle. b) Draw the profile of a cam with oscillating roller follower for the following motion: Follower to move outwards through an angular	Remember	7

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	displacement of 20^0 during 120^0 of cam rotation, follower to dwell for 50^0, follower to return to its initial position during90^0 of cam rotation with UARM, follower to dwell for the remaining period.		
4	a) Write short notes on cams and followers. b) Draw a cam to raise a valve through a distance of 50 mm in 1/3 of revolution with SHM, keep it fully raised through 1/12 of revolution and lower it with harmonic motion in 1/6 of revolution. The valve remains closed during the rest of the revolution. The diameter of the roller is 20 mm and the minimum radius of the cam is 25 mm. The axis of the valve rod passes through the axis of the cam shaft.	Understand	8
5	Draw and explain the displacement and velocity diagrams for Simple Harmonic motion.	Remember	9
6	Define the following terms as applied to cams with neat sketch: i) Base circle ii) pitch circle iii) pressure angle. b) Draw the profile of a cam with oscillating roller follower for the following motion: Follower to move outwards through an angular displacement of 20^0 during 120^0 of cam rotation, follower to dwell for 50^0, follower to return to its initial position during90^0 of cam rotation with UARM, follower to dwell for the remaining period.	Create	9
7	Write short notes on cams and followers. b) Draw a cam to raise a valve through a distance of 50 mm in 1/3 of revolution with SHM, keep it fully raised through 1/12 of revolution and lower it with harmonic motion in 1/6 of revolution. The valve remains closed during the rest of the revolution. The diameter of the roller is 20 mm and the minimum radius of the cam is 25 mm. The axis of the valve rod passes through the axis of the cam shaft.	Evaluate	10
8	a) Classify with neat sketches the cam follower according to their shape, location and motion. State also their advantages, if any, with respect to other followers b). Sketch neatly the displacement, velocity and acceleration curves of a SHM motion of Follower. Why is it superior over other motion curves?	Remember	10
9	a) Define the following terms as applied to cams with neat sketch: i) Base circle ii) pitch circle iii) pressure angle. b) Draw the profile of a cam with oscillating roller follower for the following motion: Follower to move outwards through an angular displacement of 20^0 during 120^0 of cam rotation, follower to dwell for 50^0, follower to return to its initial position during90^0 of cam rotation with UARM, follower to dwell for the remaining period	Create	9
10	Draw and explain the displacement and velocity diagrams for Simple Harmonic motion.	Apply	12
	UNIT-V **GEARS AND GEAR TRAINS**		
1	a) Explain spur, helical and bevel gears? b) Derive an expression for the length of path of contact	Understand	11
2	a) Explain the terms module, pressure angle and addendum in gears. b) Two mating gears have 29 and 40 involute teeth of module 10 mm and 20^0 pressure angle. If the addendum on ach wheel is such that the path of contact is maximum and interference is just avoided ,find the addendum for each gear wheel, path of contact, arc of contact and contact ratio.	Understand	12

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3	a) Make a comparison of cycloidal and involute profiles of gears? b) A pair of 20^0 pressure angle gears in mesh have the following data: Speed of pinion = 400 rpm, Number of teeth on pinion =24, number of teeth on gear = 28. Determine the addendum of the gears if the path of approach and recess is half the maximum value.	Apply	12
4	a)Explain the method of eliminating interference in gears. b)A pair of gears having 40 and 20 teeth respectively are rotating in mesh The speed of the smaller is 2000 rpm. Determine the velocity of sliding at the point of engagement, at the pitch point and at the point of disengagement. Assume that the gear teeth are20^0 involute, addendum is 5 mm and module is 5 mm.	Remember	11
5	a) Derive an expression for the length of arc of contact. b) The pitch circle diameter of the smaller of the two gears which mesh externally and have b) involute teeth is 100 mm. The number of teeth are 16 and32. The pressure angle is 20^0. The addendum is 0.32 of the circular pitch. Find the length of path of contact of the pair of teeth.	Remember	13
6	a) What is a gear train and what are its types? b) The speed ratio of a reverted gear train is 12. The module pitch of gears A and B which are in mesh is 3.125 mm and of gears C and D which are in mesh is 2.5 mm.Calculate the suitable number of teeth for the gears.	Evaluate	14
7	a) Explain with a neat sketch the sun and planet wheel. b) In an epicyclic b) gear train, an arm carries two gears 1 and 2 having 40 and 50 teeth respectively. The arm rotates at 160 rpm counter clockwise about the centre of gear1, which is fixed. Determine the speed fixed. Determine the speed	Evaluate	12
8	The number of teeth on each of the two spur gears in mesh is 40. The teeth have20° involute profile and the module is 6mm. If the arc of contact is 1.75 times the circular pitch. Find the addendum.	Evaluate	12
9	a)Explain with the help of displacement, velocity and acceleration diagrams the UARM.	Evaluate	13
10	a) What is a tangent cam? b) Derive an expression for the tangent cam when the follower is contacting the convex flanks.	Evaluate	14

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