Register Number:……..

KUMARAGURU
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B.E DEGREE EXAMINATIONS: MAY 2017

(Regulation 2015)

Fourth Semester

AERONAUTICAL ENGINEERING

UI5AET402 Mechanics of Machines

COURSE OUTCOMES

CO1: Predict the dynamic characteristics of mechanisms such as linkages and cams.
CO2: Identify mechanisms and predict their motion and calculate the degrees of freedom of mechanisms.
CO3: Design mechanisms to fulfill motion generation and quick return requirements.
CO4: Determine the velocity ratios for Epicyclic gear trains.
CO5: Balance simple rotating objects and pin-jointed four bar linkages and select suitable drives and mechanisms for a particular application.
CO6: Predict the unbalanced forces and couple in multi cylinder engines.

Time: Three Hours **Maximum Marks: 100**

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. Matching type item with multiple choice code CO2 [K_1]

List I	List II
A. Offset slider crank mechanism	i. Rolling pair
B. Scotch yoke mechanism	ii. Quick return mechanism
C. Gyroscope	iii. Mechanism for direction control
D. Ball bearing	iv. Sine function generator

	A	B	C	D
a)	ii	i	iii	iv
b)	iii	iv	ii	i
c)	ii	iv	iii	i
d)	iii	i	ii	iv

2. Which one of the following does not have any gyroscopic effect on ships CO1 [K_2]

a) Steering b) Pitching
c) Yawing d) Rolling

3. Consider two shafts connected with two gears as per the following options: CO4 [K_3]

1. One on each shaft

2. Through an intermediate gear mounted on an intermediate shaft, and every shaft having one gear only.

3. Through an intermediate gear mounted on an intermediate shaft, with intermediate shaft having two gears, whereas the other shafts have one gear each.

Which of the above represent(s) a simple gear train?

a) 1 only b) 1 and 2 only

c) 2 and 3 only d) 1, 2 and 3

4. A gear of 280mm pitch circle diameter has 40 teeth. The module of the gear is CO4 [K_3]

a) 7mm b) 3.5mm

c) 28mm d) 14mm

5. Assertion (A): V-threaded screw is suitable for fasteners. CO2 [K_1]

Reason (R): They have a coefficient of friction better than square threaded screws and hence have good self locking characteristic.

a) Both A and R are Individually true and R is the correct explanation of A b) Both A and R are Individually true but R is not the correct explanation of A

c) A is true but R is false d) A is false but R is true

6. Which one of the following is good assumption for the design of clutches CO2 [K_1]

a) Uniform pressure b) Uniform wear

c) Uniform axial force d) Uniform displacement

7. Consider the following to build a cam and roller follower mechanism CO1 [K_1]

1. Roller 2. Follower 3. Cam 4. Frame

The correct sequence to build the mechanism is

a) 2-3-4-1 b) 1-3-2-4

c) 3-4-1-2 d) 4-3-1-2

8. Which of the following follower motion is suitable for high speed cam applications? CO5 [K_1]

a) Uniform velocity motion b) Uniform acceleration retardation

c) Parabolic motion d) Cycloidal motion

9. Assertion (A): Reciprocating mass cannot be balanced completely. CO6 [K_4]

Reason (R): Reciprocating mass is balanced by a rotating mass

a) Both A and R are Individually true and R is the correct explanation of A

b) Both A and R are Individually true but R is not the correct explanation of A

c) A is true but R is false

d) A is false but R is true

10. Which one of the following requires static balancing? CO5 [K_3]

a) A shaft with four pulleys

b) A bicycle wheel

c) Rotor of a multi stage steam turbine

d) A multi rotor system

PART B (10 x 2 = 20 Marks)
(Answer not more than 40 words)

11. State whether the linkage shown in Fig.1 is a mechanism or not. CO2 [K_3]

12. An aero plane turns toward left, the engine rotates in clock wise direction when viewed from rear. State the effect of gyroscopic couple on the plane CO1 [K_2]

13. Two parallel shafts are provided with pulleys 480mm and 640mm in diameters, are connected by a belt. The center distance between the shafts is 3m. find the length of the belt required if it is (i) open belt drive (ii) crossed belt drive CO2 [K3]

14. What are the conditions for self locking of a screws? CO1 [K_1]

15. Define the following terms: circular pitch, module, addendum, dedendum. CO4 [K_1]

16. Find the number of degrees of freedom of a cam with roller follower. CO2 [K_3]

17. A crank and slotted lever mechanism shown in Fig.2.used in a shaper has a center distance (O_2O_4) of 300mm between the center of oscillation of slotted lever and the center of rotation of crank. The radius of the crank (O_2A_2) is 120mm. Find the quick return ratio. CO3 [K_3]

18. What are the conditions for dynamic balancing of rotating masses? CO5 [K_2]

19. Why secondary unbalanced forces are balanced in multi cylinder inline engines? CO6 [K_2]

20. What are the effects of unbalanced forces in locomotives? CO6 [K_2]

Answer any FIVE Questions:-
PART C (5 x 14 = 70 Marks)
(Answer not more than 300 words)

Q.No. 21 is Compulsory

21. A car engine has a rated output of 12kW. The maximum torque developed is 100Nm. The clutch used is of single plate type having two active surfaces. The axial pressure is not to exceed 85 kN/m^2. The outer diameter of the friction plate is 1.25 times the inner diameter. Determine the dimensions of the plate and the axial force exerted by the springs. Coefficient of the friction = 0.3 CO2 [K_4]

22. In a slider-crank mechanism shown in Fig.3, the crank O2A is 480mm long and rotates at 20 r/s in the CCW direction. The length of the connecting rod AB is 1600mm. When the crank turns 600 from IDC, determine CO3 [K_4]

    1. the velocity and acceleration of the slider.
    2. the velocity and acceleration of a point E located at a distance 450mm on the connecting rod extended.
    3. the position and velocity of a point F on the connecting rod having least absolute velocity
    4. the angular velocity and angular acceleration of the connecting rod.

23. Draw the cam profile for following conditions: CO3 [K_4]

Follower type = knife edge follower, off set to the right of cam axis by 18mm; lift = 35mm; base circle radius = 50mm; out stroke with SHM for 72^0; dwell for 18^0; and return stroke with Uniform acceleration and retardation motion, for 180^0 and dwell for the remaining period..

24. What are quick return mechanisms? Where are they used? Discuss the functioning of any one of them in detail with neat sketch. CO1 [K_3]

25. An epicyclic gear train consists of a sun gear, a stationary internal gear and three identical planet gears carried on a star shaped arm (Fig 4). The arm rotates at $1/5^{th}$ of the speed of the sun gear. The minimum number of teeth on any wheel is 16. The driving torque on the sun gear is 100 Nm. Determine: CO4 [K_4]

1. Number of teeth on each gear and
2. Torque necessary to hold the internal gear stationary.

26. Four masses A, B, C and D are completely balanced. Masses C and D are at angles of 90^0 and 195^0 respectively with B in the same sense. The rotating masses have the following properties. CO5 [K_4]

m_b=25kg	r_a=150mm
m_c=40kg	r_b=200mm
m_d=35kg	r_c=100mm
	r_d=180mm

Planes B and C are 250mm apart. Determine

i. The mass A and its angular position

The positions of planes A and D

27. The crank and connecting rods of a 4-cylinder in-line engine running at 1800rpm are 60mm and 240mm each respectively and the cylinders are spaced 150mm apart. If the cylinders are numbered 1 to 4 in sequence one end, the cranks appear at intervals of 90^0 in an end view in the order 1-4-2-3. The reciprocating mass corresponds to each cylinder is 1.5kg. Determine: CO6 [K_4]

1. Unbalanced primary and secondary forces if any, and
2. Unbalanced primary and secondary couples with reference to central plane of the engine.

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