

B.E DEGREE EXAMINATIONS: DEC 2014

(Regulation 2009)

Third Semester

AUTOMOBILE ENGINEERING

AUE 101: Mechanics of Machines

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

1. The component of acceleration, parallel to the velocity of the particle, at the given instant is called
 - a) Radial component
 - b) tangential component
 - c) Coriolis component
 - d) none of these
2. The lead screw of a lathe with nut forms a
 - a) Sliding pair
 - b) Rolling pair
 - c) Screw pair
 - d) Spherical pair
3. Which of the following is not a flexible type of connector?
 - a) Belt
 - b) Rope
 - c) Chain
 - d) Gear
4. The effect of slip on velocity ratio of the belt is to
 - a) increase the velocity ratio
 - b) decrease the velocity ratio
 - c) keep the velocity ratio constant
 - d) none of the above
5. The cam follower generally used in automobile engine is
 - a) knife edge follower
 - b) flat faced follower
 - c) spherical faced follower
 - d) roller follower
6. The module is defined as equal to the ratio of
 - a) Number of teeth to pitch circle diameter
 - b) Pitch circle diameter to number of teeth
 - c) Circumference of pitch circle to number of teeth
 - d) none of the above
7. The balancing weights are introduced in planes parallel to the plane of rotation of the disturbing mass. To obtain complete dynamic balance, the minimum number of balancing weights to be

introduced in different planes is

- | | |
|------|------|
| a) 1 | b) 2 |
| c) 3 | d) 4 |
8. Unbalanced force is also called as
- | | |
|---------------------|------------------|
| a) Tangential force | b) shaking force |
| c) circular force | d) radial force |
9. A torsional vibratory system having three rotors connected by a shaft has
- | | |
|----------------|--------------|
| a) One node | b) Two nodes |
| c) Three nodes | d) No node |
10. The ratio of the maximum displacement of the forced vibration to the deflection due to the static force is known as
- | | |
|---------------------|--------------------------|
| a) Damping factor | b) Logarithmic decrement |
| c) transmissibility | d) Magnification factor |

PART B (10 x 2 = 20 Marks)

11. What is meant by kinematic link?
12. Define inversion of a mechanism.
13. What do you understand by slip in belt drives?
14. Give the different types of clutches.
15. What is meant by interference in gear?
16. What is meant by prime circle?
17. Why the balancing is necessary for rotors of high speed engines?
18. Give the conditions to be satisfied for dynamic balancing.
19. Classify vibration.
20. What is meant by amplitude reduction factor?

PART C (5 x 14 = 70 Marks)

21. a) (i) Draw and explain the working of slider crank mechanisms with neat sketch. (7)
- (ii) Explain the following: (7)
- a) Kinematic Link
 - b) Kinematic pair and
 - c) Kinematic chain

(OR)

- b) The crank and connecting rod of a theoretical steam engine are 0.5 m and 2 m long respectively. The crank makes 180 r.p.m. in the clockwise direction. When it has turned 45° from the inner dead centre position, determine 1. Velocity of

piston, 2. Angular velocity of connecting rod, 3. Velocity of point E on the connecting rod 1.5 m from the gudgeon pin, 4. Velocities of rubbing at the pins of the crank shaft, crank and cross head when the diameters of their pins are 50 mm, 60 mm, and 30 mm respectively, 5. Position and linear velocity of any point G on the connecting rod which has the least velocity relative to crank shaft.

22. a) An open belt running over two pulleys 240 mm and 600 mm diameter connects two parallel shafts 3 meter apart and transmits 4kW from the smaller pulley that rotates at 300 rpm. 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 tension 3. Length of the belt required.

(OR)

- b) A square threaded bolt of root diameter 22.5 mm and pitch 5 mm is tightened by screwing a nut whose mean diameter of bearing surface is 50 mm. If the coefficient of friction for nut and bolt is 0.1 and for nut and bearing surface is 0.16, find the force required at the end of a spanner 500 mm long when the load on the bolt is 10kN.

23. a) A compound train consists of six gears. The number of teeth on the gears as follows:

Gear:	A	B	C	D	E	F
No. of teeth:	60	40	50	25	30	24

The gear B and C are on one shaft while the gears D and E are on another shaft. The Gear A drives gear B, gear C drives gear D and gear E drives gear F. If the gear A transmits 1.5 kW at 100r.p.m. and the gear train has an efficiency of 80%, find the torque on gear F.

(OR)

- b) Design a cam for operating the exhaust valve of an oil engine. It is required to give equal uniform acceleration during opening and closing of the valve each of which corresponds to 60° of cam rotation .The values must remain in the fully open position for 20° of cam rotation. The lift of the valve is 37.5 mm and the least radius of the cam is 40 mm. The follower is provided with a roller of radius 20mm and its line of stroke passes through the axis of the cam.

24. a) A shaft carries four masses A,B,C and D of magnitude 200 kg, 300 kg, 400 kg

and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45° , B to C 70° , and C to D 120° . The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions.

(OR)

- b) In an in-line six cylinder engine working on two stroke cycle, the cylinder centre lines are spaced at 600 mm. In the end view, the cranks are 60° apart and in the order 1-4-5-2-3-6. The stroke of each piston is 400 mm and the connecting rod is 1 m. The mass of the reciprocating parts is 200 kg per cylinder and that of rotating parts 100 kg per crank. The engine rotates at 300 r.p.m. Examine the engine for the balance of primary and secondary forces and couples. Find the maximum unbalanced forces and couples.

25. a) A vertical shaft of 5 mm diameter is 200 mm long and is supported in long bearing at its ends. A disc of mass 50 kg is attached to the centre of the shaft. Neglecting any increase in stiffness due to the attachment of the disc to the shaft, find the critical speed of rotation and the maximum bending stress when the shaft is rotating at 75% of the critical speed. The centre of the disc is 0.25 mm from the geometric axis of the shaft. $E=200\text{GN/m}^2$.

(OR)

- b) The mass of an electric motor is 120 kg and it runs at 1500 r.p.m. The armature mass is 35 kg and its C.G. lies 0.5 mm from the axis of rotation. The motor is mounted on five springs of negligible damping so that the force transmitted is one-eleventh of the impressed force. Assume that the mass of the motor is equally distributed among the five springs. Determine (i) Stiffness of each spring; (ii) dynamic force transmitted to the base at the operating speed; and (iii) natural frequency of the system.
