| Name:<br>Enrolment No: | UPES |
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# UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

## End Semester Examination, July, 2020

**Programme Name: B.Tech ASE** **Semester : IV**
**Course Name : Theory of Machine** **Time : 03 hrs**
**Course Code : MECH2013** **Max. Marks : 100**
**Nos. of page(s) : 6**
**Instructions: All questions are compulsory.**

## SECTION A

| S. No. | Multiple Choice | Marks | CO |
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| Q 1 | A piston and cylinder of reciprocating steam engine forms a<br>a. Turning pair<br>b. Rolling pair<br>c. Sliding pair<br>d. None of the above | **1** | (CO1) |
| Q 2 | When the two elements of a pair have a surface contact when a motion and the surface of an element slides over the surface of the other elements, the pair formed is called a<br>a. Higher pair<br>b. Lower pair<br>c. Forced closed pair<br>d. None of the above | **1** | (CO1) |
| Q 3 | Whiteworth quick return mechanism is an inversion of<br>a. Double slider crank chain<br>b. Single slider crank chain<br>c. Four bar chain<br>d. None of the above | **1** | (CO1) |
| Q 4 | _____ is an inversion of Double slider crank chain.<br>a. Coupling rod of a locomotive<br>b. Scotch yoke mechanism<br>c. Hand pump<br>d. Reciprocating engine | **1** | (CO1) |
| Q 5 | The Kutzbach criterion for determining the number of degrees of freedom (n) is (where l = number of links, j = number of joints and h = number of higher pairs)<br>a. **n** = 3(l-1)-2j-h<br>b. n = 2(l-1)-2j-h<br>c. n = 3(l-1)-3j-h<br>d. n = 2(l-1)-3j-h | **1** | (CO1) |
| Q 6 | The instantaneous centres which vary with the configuration of the mechanism, are called | **1** | (CO2) |

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| | a. Permanent instantaneous centres<br>b. Fixed instantaneous centres 1<br>c. **N**either fixed nor permanent instantaneous centres<br>d. None of these | | |
| Q 7 | In the above question, if both the links OA and OB turn in clockwise direction, then the rubbing velocity at the pin joint O is<br>a. ω1 .ω2.r<br>b. (ω1 – ω2) r<br>c. (ω1 + ω2) r<br>d. (ω1 – ω2) 2 r | **1** | (CO2) |
| Q 8 | In a simple gear train, if the number of idle gears is odd, then the motion of driven gear will<br>a. be same as that of driving gear<br>b. be opposite as that of driving gear<br>c. depend upon the number of teeth on the driving gear<br>d. none of the above | **1** | (CO4) |
| Q 9 | When the axes of first and last gear are co-axial, then gear train is known as<br>a. simple gear train<br>b. compound gear train<br>c. reverted gear train<br>d. epicyclic gear train | **1** | (CO4) |
| Q 10 | In a gear train, when the axes of the shafts, over which the gears are mounted, move relative to a fixed axis, is called<br>a. simple gear train<br>b. compound gear train<br>c. reverted gear train<br>d. epicyclic gear train | **1** | (CO4) |
| Q 11 | A disc is spinning with an angular velocity ω rad/s about the axis of spin. The couple applied to the disc causing precession will be<br>a. $1/2\ I\ \omega^2$<br>b. I.ω2<br>c. $1/2\ I\ \omega\ \omega_p$<br>d. $I.\omega.\omega_p$ | **1** | (CO4) |
| Q 12 | A disc spinning on its axis at 20 rad/s will undergo precession when a torque 100 N-m is applied about an axis normal to it at an angular speed, if mass moment of inertia of the disc is the 1 kg-m2<br>a. 2 rad/s<br>b. 5 rad/s<br>c. 10 rad/s<br>d. 20 rad/s | **1** | (CO4) |
| Q 13 | The engine of an aeroplane rotates in clockwise direction when seen from the tail end and the aeroplane takes a turn to the left. The effect of the gyroscopic couple on the aeroplane will be<br>a. to raise the nose and dip the tail<br>b. to dip the nose and raise the tail<br>c. to raise the nose and tail<br>d. to dip the nose and tail | **1** | (CO4) |

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| Q 14 | The air screw of an aeroplane is rotating clockwise when looking from the front. If it makes a left turn, the gyroscopic effect will<br>a. tend to depress the nose and raise the tail<br>b. tend to raise the nose and depress the tail<br>c. tilt the aeroplane<br>d. none of the above | **1** | (CO4) |
| Q 15 | The rotor of a ship rotates in clockwise direction when viewed from the stern and the ship takes a left turn. The effect of the gyroscopic couple acting on it will be<br>a. to raise the bow and stern<br>b. to lower the bow and stern<br>c. to raise the bow and lower the stern<br>d. to lower the bow and raise the stern | **1** | (CO4) |
| Q 16 | When the pitching of a ship is upward, the effect of gyroscopic couple acting on it will be<br>a. to move the ship towards port side<br>b. to move the ship towards star-board<br>c. to raise the bow and lower the stern<br>d. to raise the stern and lower the bow | **1** | (CO4) |
| Q 17 | For a given lift of the follower of a cam follower mechanism, a smaller base circle diameter is desired.<br>a. because it will give a steeper cam and higher pressure angle.<br>b. because it will give a profile with lower pressure angle<br>c. because it will avoid jumping<br>d. none of the above | **1** | (CO4) |
| Q 18 | A circle drawn with centre as the cam centre and radius equal to the distance between the cam centre and the point on the pitch curve at which the pressure angle is maximum, is called<br>a. base circle<br>b. pitch circle<br>c. prime circle<br>d. none of these | **1** | (CO4) |
| Q 19 | The size of a cam depends upon<br>a. base circle<br>b. pitch circle<br>c. prime circle<br>d. pitch curve | **1** | (CO4) |
| Q 20 | The angle between the direction of the follower motion and a normal to the pitch curve is called<br>a. pitch angle<br>b. prime angle<br>c. base angle<br>d. pressure angle | **1** | (CO4) |
| Q 21 | The balancing of rotating and reciprocating parts of an engine is necessary when it runs at<br>a. slow speed<br>b. medium speed<br>c. high speed | **1** | (CO3) |
| Q 22 | A disturbing mass m1 attached to a rotating shaft may be balanced by a single mass m2 attached in the same plane of rotation as that of m1 such that | **1** | (CO3) |

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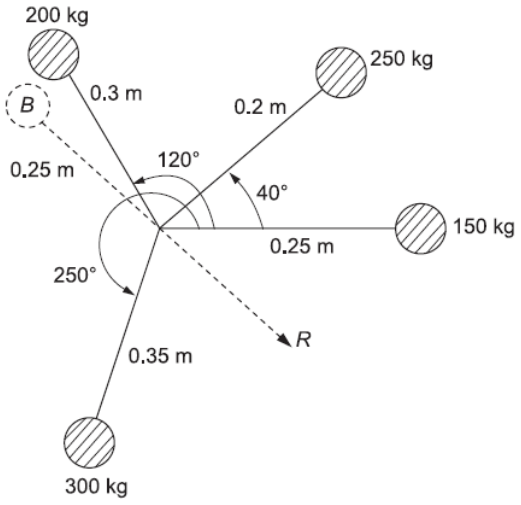
| | a. m1.r2 = m2.r1<br>b. m1.r1 = m2.r2<br>c. m1. m2 = r1.r2 | | |
| Q 23 | For static balancing of a shaft<br>a. the net dynamic force acting on the shaft is equal to zero<br>b. the net couple due to the dynamic forces acting on the shaft is equal to zero<br>c. both (a) and (b)<br>d. none of the above 4. | **1** | (CO3) |
| Q 24 | For dynamic balancing of a shaft<br>a. the net dynamic force acting on the shaft is equal to zero<br>b. the net couple due to dynamic forces acting on the shaft is equal to zero<br>c. both (a) and (b)<br>d. none of the above | **1** | (CO3) |
| Q 25 | Which of the following statement is correct?<br>(a) In any engine, 100% of the reciprocating masses can be balanced dynamically<br>(b) In the case of balancing of multicylinder engine, the value of secondary force is higher than the value of the primary force<br>(c) In the case of balancing of multimass rotating systems, dynamic balancing can be directly started without static balancing done to the system<br>(d) none of the above. | **1** | (CO3) |
| | **SECTION B** | | |
| Q 1 | Four masses 150 kg, 250 kg, 200 kg and 300 kg are rotating in the same plane at radii of 0.25 m, 0.2 m, 0.3 m, and 0.35 m respectively. Their angular location is 40°, 120°, and 250° from mass 150 kg, respectively measured in counter-clockwise direction. Find the position and magnitude of the balance mass required, if its radius of rotation is 0.25 m.<br>  <br> | **15** | **CO3** |

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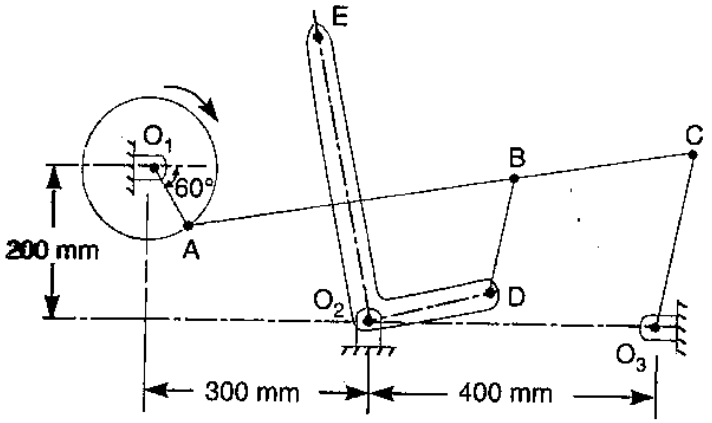
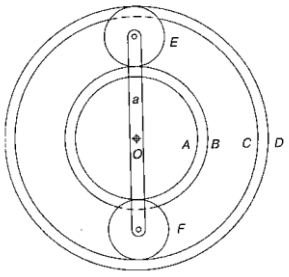
| Q 2 | The mechanism of wrapping machine, as shown in figure below, has the following dimensions: $O_1A$ = 100 mm; AC = 700 mm; BC = 200 mm; $O_3C$ = 200 mm; $O_2E$ = 400 mm; $O_2D$ = 200 mm and BD = 150 mm. The crank $O_1A$ rotates at a uniform speed of 100 rad/s. Find the velocity of the point E of the bell crank lever by relative velocity method.<br>  <br> | 15 | **CO2** |
| Q 3 | In an epicyclic gear train shown in Fig. the compound wheels A and B as well as internal wheels C and D rotate independentaly about the axis O. The wheels E and F rotate on the pins fixed to arm a. All the wheels are of the same module. The number of teeth on the wheels are<br>$T_A$= 52, $T_B$= 56, $T_E$= $T_F$= 36<br>Determine the speed of C if<br>(i) the wheel D fixed and arm A rotates at 200 rpm clockwise<br>(ii) the wheel D rotates at 20 rpm CCW and the arm A rotates at 200 rpm CW.<br>  <br> | **15** | **CO4** |
| Q 4 | Cam with 25 mm minimum radius has to give the motion to the roller follower 12 mm diameter as follows:<br>(a) Follower to complete outward stroke of 25 mm during '110° of cam rotation with S.H.M<br>(b) Follower to return to its initial position during next 90° of cam rotation with S.H.M. Layout the cam profiles when:<br>The follower axis is passing through the axis of rotation of the cam. | **15** | **CO4** |

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| Q 5 | A disc cam with base circle radius of 50 mm is operating a roller follower with SHM. The lift is 25 mm, angle of ascent 120°, dwell 90°, return 90°, and dwell during the remaining period. The cam rotates at 300 rpm. Find the maximum velocity and acceleration during ascent and descent. The roller radius is 10 mm. Draw the cam profile when the line of reciprocation of follower passes through the cam axis. | **15** | **CO4** |