## BE Semester-_V___ (Mechanical Engineering) Question Bank

## (Dynamics of Machines)

### All questions carry equal marks(10 marks)

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| Q.1 | What is the function of a governor? How does it differ from a flywheel?<br>(ii) Explain the terms relating to governor.<br>Sensitiveness, Hunting and Stability |
| Q.2 | What is gyroscopic couple? Derive a relation for its magnitude. |
| Q.3 | A Porter governor has arms of 380 mm long. The upper arms are pivoted at the axis of the sleeve and lower arms are attached to the sleeve at a distance of 40 mm from the axis. Each fly ball has a mass of 5 kg. and weight on sleeve is 45 kg. Find the range of speed of the governor if the extreme radii of rotation of the balls are 250 mm and 300 mm. The force of friction on sleeve of mechanism is 30 N. |
| Q.4 | The following data refers to a **Hartnell governor**.<br>Length of horizontal arms of bell crank lever = 40 mm and<br>Length of vertical arms of bell crank lever = 80 mm<br>Mass of each flying ball 1.2 kg. , The maximum radius of rotation = 100 mm, The minimum radius of rotation = 70 mm, The distance of fulcrum to axis of rotation = 75 mm, Minimum equilibrium speed = 400 rpm, Maximum equilibrium speed 5 % higher than minimum equilibrium speed. Neglecting obliquity of arms determine: (i) spring stiffness (ii) initial compression |
| Q.5 | D'Alembert's principle and Dynamically equivalent system. |
| Q.6 | The crank and connecting rod of a vertical petrol engine running at 1800 rpm are 60 mm and 260 mm respectively. The diameter of piston is 100 mm and the mass of the reciprocating parts is 1.2 kg. During the expansion stroke when the crank has turned 200 from the top dead center, the gas pressure is 600 kN/m2. Determine (i) net force on the piston, (ii) net load on gudgeon pin, (iii) Thrust on the cylinder walls. |
| Q.7 | Explain the terms: Function generation, path generation and motion Generation and derive frudenstein's eqution. |
| Q.8 | A two wheeler motor vehicle and its rider weight 225 kg and their combined center of gravity is 600 mm above the ground level, when the vehicle is upright. Each road wheel is of 600 mm diameter and has a moment of inertia of 1 kgm2 The rotating parts of the engine have a moment of inertia of 0.175 kgm2. The engine rotates at 5.5 times the speed of the road wheels and in the same sense. |

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| | Determine the angle of heel necessary, when the vehicle is rounding a curve of 30 m radius at a speed of 55 km/hr. |
| Q.9 | The turbine rotor of a ship has a mass of 3500 kg. It has a radius of gyration of 0.45 m and a speed of 3000 rpm clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship:<br>1. When the ship is steering to left on a curve of 100 m radius at a speed of 36 km/h<br>2. When the ship is pitching in a simple harmonic motion, the bow falling with Its maximum velocity. The period of pitching is 40 seconds and the total angular Displacement between the two extreme positions of pitching is 12 degrees. |
| Q.10 | The arms of a porter governor are each 25 cm long and pivoted on the governor axis. Mass of each ball is 5 kg and mass of the central sleeve is 30 kg. The radius of rotation of the balls is 15 cm when the sleeve begins to rise and reaches a value of 20 cm for maximum speed. Determine the range of the governor. |
| Q.11 | A car is of total mass 2200 kg has the track width 1.5 m. Each wheel having an effective diameter 0.66 m and the mass moment of inertia 2.4 kg m2.<br>The mass moment of inertia of rotating parts of the engine is 1.2 kg m2.The engine axis is parallel to the rear axle and the crankshaft rotates in the same sense as the road wheels. The gear ratio of the engine to the rear wheel is 3.<br>The centre of mass of the car is 0.55 m above the road level. If the car is rounding a curve of 80 m radius at a speed of 100 km/h, determine the load distribution on the inner and outer wheels. |
| Q.12 | Explain: geometry of spur, helical and bevel gears. |
| Q.13 | The turbine rotor of a ship has mass of 2000 kg and rotates at 25 rev./sec clockwise when viewed from the stern. The radius of gyration of rotor is 0.30 meter. Determine gyroscopic couple and its effect when<br>(i) The ship turns right at a radius of 250 m with a speed of 25 kM/hr.<br>(ii) The ship rolls at an angular velocity of 0.1 rad/sec. |
| Q.14 | A porter governor has equal arms 200mm long pivoted on the axis of rotation. The mass of each ball is 3 kg and the mass on the sleeve is 15kg.The ball path is 120 mm when the governor begins to lift and 160mm at the maximum speed. Determine the range of speed.<br>If the fraction at the sleeve is equivalent to a force of 10 N, find the co efficient of insensitiveness. |
| Q.15 | The turbine rotor of a ship has a mass of 2.2 tones and rotates at 1800 |

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| | r.p.m. clockwise when viewed from the left. The radius of gyration of the rotor is 320mm. Determine the gyroscopic couple and its effect when (1) Ship turns right at a radius of 250m. with a speed of 25 km/hr.(2)Ship pitches with the bow rising at an angular velocity of 0.8 rad/sec. (3)Ship rolls at an angular velocity of 0.1 rad/sec. |
| Q.16 | Derive an expression for angle of heel of a two wheeler taking turn. |
| Q.17 | Derive the equation for finding out the ratio of angular velocities of two shafts of Hooke's joint. |
| Q.18 | Derive the equation for finding out the length of path of contact for a pair of involute gears. |
| Q.19 | A pair $20^0$ involute gears has module of 5 mm. The pinion has 20 teeth and gear has 60 teeth. Addendum on the pinion and gear wheel in terms of module is one. Find the followings:<br>(1) Number of pairs in contact.<br>(2) Angle turned through by the pinion and gear wheel for one pair in contact. |
| Q.20 | Two 20° involute spur gear mesh externally and give a velocity ratio of 3. The module is 3 mm and the addendum is equal to 1.1 modules. If the pinion rotates at 120 rpm, determine:<br>(i) minimum number of teeth on each wheel to avoid interference<br><br>(ii) Contact Ratio. |
| Q.21 | Define "Inversion of Mechanism". Draw sketches of any two inversions of double slider crank mechanism and State their applications. |
| Q.22 | Explain: law of gearing. |
| Q.23 | Explain:: (1) Contact Ratio (2) Module (3) Circular pitch (4) Addendum |
| Q.24 | Two mating involute spur gear of 20 degree pressure angle have a gear ratio of 2. The number of teeth on the pinion is 20 and its speed is 250 rpm. Module pitch of the teeth is 12 mm. Find: (1) The addendum for pinion (2) The addendum for gear wheel & (3) The length of the arc of contact. Assume pinion to be the driver |
| Q.25 | Explain effort and power of Governor. |
| Q.26 | What is meant by terms sensitiveness, stability and hunting in governing mechanism? |
| Q.27 | An aeroplane makes a complete half circle of 50 m radius, towards left, when flying at 200 km per hour. The rotary engine and the propeller of the plane have a mass of 400 kg. with the radius of gyration of 300 mm. The engine |

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| | runs at 2400 r.p.m. clockwise, when viewed from the rear. Find the gyroscopic couple on the aircraft and state its effect on it. What will be the effect, if the aeroplane turns to its right instead of to the left? |
| Q.28 | A four bar mechanism is to be designed, by using three precision points, to generate the function $y = x^{1.5}$, for the range $1 \leq x \leq 4$. Assuming 30° starting position and 120° finishing position for the input link and 90° starting position and 180° finishing position for the output link, find the values of x, y, θ and φ corresponding to the three precision points |
| Q.29 | Explain: Watt governor and derive the equation for height of governor. |
| Q.30 | In a porter governor, upper links are 250 mm long hinged at 25 mm from the governor shaft axis and lower links are 350 mm long hinged to the sleeve at 30 mm from the shaft axis. Sleeve mass is 50 kg and rotating masses are 5 kg each. The rotating masses rotating at a radii of 210 mm. If the speed suddenly changes by 6%. Find out governor effort and power. |
| Q.31 | Determine the Chebyshev spacing for function $y=x^{1.5}$ for the range $0 \leq x \leq 3$ where three precision points are required. |
| Q.32 | Classify centrifugal governors. What is the difference between centrifugal and inertia type governors? |
| Q.33 | Explain the effect of gyroscopic couple on aeroplane. |
| Q.34 | Derive an expression for the minimum number of teeth required on the pinion in order to avoid interference in involute gear teeth when it meshes with wheel. |
| Q.35 | The distance between two parallel shafts connected by Oldham's coupling is 20mm. The speed of the driving shaft is 240 RPM .find the maximum speed of the tongue of the intermediate piece in the grooves of the flange. |
| Q.36 | Explain: Oldham's coupling. |
| Q.37 | Two involute gears of 20 degree pressure angle are rotating in mesh. The speed of smaller gear is 1440 RPM. The number of teeh on pinion is 20 and gear ratio is 2.If the addendum of pinion and wheel is standard and equal to one module and odule is 5mm find. length of path of contact, length of arc of contact, velocity of sliding at the point of contact. |
| Q.38 | Two shafts are connected by a Hooks joint .The angle between them is 15 degree. If the driving shaft rotates at 500 RPM find speed of a driven shaft and maximum acceleration |
| Q.39 | Explain: Engine force analysis in slider crank mechanism. |
| Q.40 | Explain: Inertia force and Shaking force. |