Code No:R2022032 **R20** **SET - 1**

II B. Tech II Semester Regular Examinations, June/July - 2022

DYNAMICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours **Max. Marks: 70**

Answer any **FIVE** Questions each Question from each unit
All Questions carry **Equal** Marks

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UNIT-I

1 a) An effective diameter of the cone clutch is 75 mm. The semi-angle of the cone is 18°. Find the torque required to produce slipping of the clutch if an axial force applied is 200 N. This clutch is employed to connect an electric motor running uniformly at 100 r.p.m with a flywheel which is initially stationary. The flywheel has a mass of 13.5 kg and its radius of gyration is 150 mm. Calculate the time required for the flywheel to attain full speed, and also the energy lost in the slipping of the clutch. Take coefficient of friction as 0.3 [9M]

b) Explain the working principle of rope brake dynamometer. [5M]

Or

2 A band brake used for a winch is wound round a drum of 0.75 m diameter, keyed to the shaft. The two ends of the band are attached to the pins on the opposite sides of the fulcrum of the brake lever at distances of 25 mm and 100 mm from the fulcrum. The angle of lap on the drum is 240°. The coefficient of friction is 0.25. Find the torque which can applied by the brake when a force of 500 N applied to the lever upwards at a distance of 1 m from the fulcrum. Consider clockwise and counter-clockwise directions of rotation. [14M]

UNIT-II

3 a) What is Turning Movement diagram? Mention its uses. [5M]

b) A certain machine requires a torque of (1500+200 sinθ)N-m to drive it where θ is the angle of rotation of shaft. The machine is directly connected to an engine which produces a torque (1500+250 sin θ) N-m. The flywheel and other rotating parts have a mass 300 kg at radius of gyration 200mm. Mean speed is 200 rpm. Find: (i) Kinetic Energy of flywheel (ii) Percentage coefficient of fluctuation of speed (iii) Crank angle at Maximum Turning Moment. [9M]

Or

4 a) Explain the dynamic force analysis of slider crank mechanism. [7M]

b) A Punching press is driven by a constant torque electric motor. The press is provided with a flywheel that rotates at maximum speed of 225 rpm. The radius of gyration of the flywheel is 0.5m.The press punches 720 holes per hour, each punching operation takes 2 seconds and requires 15 kN-m of energy. Find the power of the motor and minimum mass of the flywheel if speed of the same is not to fall below 200 rpm? [7M]

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UNIT-III

5 The arms of a Hartnell governor are of equal length. When the sleeve is in the mid-position, the masses rotate in a circle of diameter 200mm (the arms are verticalin the mid-position). Neglecting friction, the equilibrium speed for this position is 300rpm. Maximum variation of speed, taking friction into account, is to be $\pm$ 5% of the mid-position speed for a maximum sleeve / movement of 25mm. The sleeve mass is 5kg and the friction at the sleeve is 30N.Assuming that the power of the governor is sufficient to overcome the friction by 1 % change of speed on each side of the mid-position, find (neglecting obliquity effect of arms). [14M]

i) The mass of each rotating ball
ii) The spring stiffness
iii) The initial compression of the spring

Or

6 a) An aircraft consists of a propeller. It also consists of engine and propeller mass moment of inertia 150 kg m^2. The engine rotates at 3600 rpm in a sense clockwise looking from rear. The aircraft completes half circle of radius 100 m towards left when flying at 360 km per hr. Determine the gyroscopic couple on the air-craft and state its effect. [9M]

b) Explain the effect of precession motion on the stability of motor cycle. [5M]

UNIT-IV

7 Three cylinders of an air compressor have their axes 120^0 to one another and their connecting rods are coupled to a single crank. The stroke is 12cm and the length of each connecting rod 20cm. The mass of the reciprocating parts per cylinders is 2Kg. Determine the maximum primary and secondary forces acting on the frame of the compressor when running at 2500 rpm. Describe the method by which such forces may be balanced. [14M]

Or

8 a) Distinguish between balancing of inline engines and radial engines with appropriate examples. [7M]

b) Derive expression for Hammer blow as applied to a locomotive balancing. [7M]

UNIT-V

9 a) Distinguish between longitudinal, transverse and torsional free vibrations. [7M]

b) A rotor of mass 10 kg is mounted min-way on a 2cm diameter horizontal shaft supported at the ends by two bearings. The bearing span is 80 cm. Because of certain manufacturing defect, the centre of gravity of the disc is 0.1 mm away from the geometric centre of the rotor. If the system rotates at 3000 rpm, determine the amplitude of the steady state vibration and the dynamic load transmitted by the bearing. Take £=200 GN/m^2. [7M]

Or

10 Two rotors A and B are attached to the ends of a shaft 600mm long. The mass of the rotor A is 400Kg and its radius of gyration is 400mm. The corresponding values of rotor B are 500Kg and 500mm respectively. The shaft is 80mm diameter for the first 250mm, 120mm diameter for next 150mm and 100mm diameter for the remaining length. Modulus of rigidity of the shaft material is 0.8 x 10^5 MN/m^2. Find the position of the node, the frequency of torsional vibrations? [14M]

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DYNAMICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours **Max. Marks: 70**

Answer any **FIVE** Questions each Question from each unit
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UNIT-I

1 a) A cone clutch is used for transmittals a torque of 3 x 10^6 N M. The mean diameter is 20 mm and the semi cone angle is 12^0 30. The coefficient of friction if 0.25 and the normal pressure at the mean radius must not exceed 1.4 x 10^5 N/m^2. Calculate the necessary width of the contact surface. Also find the axial force needed to hold the clutch surface together. [8M]

b) Explain working of belt transmission dynamometer in detail. [6M]

Or

2 A band and block brake having 12 blocks, each of which subtends 15° at the centre, is applied to a rotating drum of 600 mm diameter. The blocks are 75 mm thick. The drum and the flywheel mounted on the same shaft have a mass of 1800 kg and have combined radius of gyration of 600 mm. The two ends of the band are attached to pins on the opposite sides of the brake fulcrum at distances of 40 mm and 150 mm from the fulcrum. Calculate (i) the maximum braking torque, (ii) the angular retardation of the drum, (iii) the time taken by the system to be stationary from the rated speed of 300 r.p.m. Take coefficient of friction is 0.3 [14M]

UNIT-II

3 The torque delivered by two stroke engine represented by $T=1000+300 \sin 2\theta-500 \cos\theta$ N-m where θ is the angle made by the crank from IDC. The engine speed is 250rpm. The mass of flywheel is 400 kg and radius of gyration is 400mm. Determine: i) Total percentage of fluctuation of speed. ii) The angular acceleration of flywheel when the crank has rotated through an angle of 60^o from IDC.iii) The maximum angular retardation of flywheel. [14M]

Or

4 A machine has to carry out punching operation at the rate of 10 holes per minute. It does 6 kN-m of work per mm^2 of the sheared area on cutting 25 mm diameter holes in 20mm thick plates. A flywheel is fitted to the machine shaft which is driven by a constant torque. The fluctuation of speed is between 180 and 200 rpm. The actual punching takes 1.5 seconds. The frictional losses are equivalent to 1/6 of the work done during punching. Find: 1. power required to drive the punching machine, and 2. Mass of the flywheel, if the radius of gyration of the wheel is 0.5m. [14M]

UNIT-III

5 a) Derive an expression for the height of Proell governor. [5M]

b) Calculate the minimum speed of a Proell governor, which has equal arms each 200mm and arepivoted on the axis of rotation. The mass of each ball is 4kg and the central mass on the sleeve is 20kg. The extension arms of the lower links are each 60mm long and parallel to the axis when the minimum radius of the ball is 100mm. [9M]

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6 The rotor of a turbine installed in a boat with its axis along the longitudinal axis of the boat makes 1500 rpm clockwise when viewed from the stern. The rotor has a mass of 750 kg and a radius of gyration of 300mm. If at an instant, the boat pitches in the longitudinal vertical plane so that bow rises from the horizontal plane with an angular velocity of 1 rad/s, determine the torque acting in the boat and the direction in which it tends to turn the boat at the instant. [14M]

UNIT-IV

7 a) Explain the role of reference plane in balancing masses of rotation in different planes. [5M]

b) A,B,C and D are from masses carried by a rotating shaft at radii 100mm, 150mm, 150mm and 200mm respectively. The planes in which masses rotate are spaced at 500mm apart and the magnitude of the masses, B, C, and D are 9Kg, 5Kg and 4Kg respectively. Find the required mass A and the relative angular settings of the four masses so that the shaft shall be in complete balance. [9M]

Or

8 A single cylinder reciprocating engine runs at 150 r.p.m. The stroke is 30 cm, mass of reciprocating parts 100 kg mass of revolving parts assumed concentrated at the crank pin is 120 kg. Find the magnitude of the balance mass required to be placed opposite at the crank at a radius of 16 cm, which is equivalent to all of the revolving and two thirds of the reciprocating masses. If the crank turns 450 from the inner dead centre, find the magnitude of unbalance force due to the balance mass. [14M]

UNIT-V

9 a) A shaft of 10 cm diameter and 100 cm long is fixed at one end and other end carries a flywheel of mass 80 kg. Taking young's modulus for the shaft material as 2×10^6 kg/cm^2, find the natural frequency of longitudinal and transverse vibrations? [8M]

b) Explain the critical speeds and whirling of shafts in detail. [6M]

Or

10 a) Derive an equation for the natural frequency of free transverse vibration of a shaft loaded with a number of concentrated loads, by energy method. [7M]

b) A steel shaft 6 cm diameter and 50 cm long fixed at one end carries a flywheel of mass 100 kg and radius of gyration 30 cm at its free end. Find the frequency of free longitudinal and transverse vibrations. [7M]

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Code No:R2022032 **R20** **SET - 3**

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DYNAMICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours **Max. Marks: 70**

Answer any **FIVE** Questions each Question from each unit
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UNIT-I

1 a) Illustrate the working of a band and block brake with the help of a neat sketch. Deduce the relation for ratio of tight and slack side tensions. [8M]

b) A plain collar type thrust bearing having inner and outer diameters of 200 mm and 450 mm is subjected to an axial thrust of 40 kN. Assuming coefficient of friction between the thrust surfaces as 0.025, find the power absorbed in overcoming friction at a speed of 120 rpm. The rate of wear is considered to be proportional to the pressure and rubbing speed. [6M]

Or

2 a) Analyze the working of a single plate friction clutch with a neat sketch? [6M]

b) In a band and block brake, the band is lined with 14 blocks, each of which subtends an angle of 200 at the drums centre. One end of the band is attached to the fulcrum of the brake lever and the other to a pin 150mm from the fulcrum. Find the force required at the end of the lever 1m long from the fulcrum to give a torque of 4kN-m. The diameter of the brake drum is 1m and the coefficient of friction between the blocks and the drum is 0.25. [8M]

UNIT-II

3 The equation of the turning moment diagram for a three-crank engine is given by $T(N\text{-}m) = 25000 - 7500 \sin 3\theta$, where θ radians is the crank angle from the inner dead centre. The moment of inertia of the flywheel is 400 kg-m^2, and the mean engine speed is 300 rpm. Calculate the power of the engine and the total percentage fluctuation of speed of the flywheel, if the resisting torque is constant. [14M]

Or

4 a) Find the maximum and minimum speeds of a flywheel of mass 3250 kg and radius of gyration 1.8 m, when the fluctuation of energy is 112 kN-m. The mean speed of the engine is 240rpm. [8M]

b) Describe about angular velocity and acceleration of connecting rod? [6M]

UNIT-III

5 A governor of the Hartnell type has equal balls of mass 3Kg, set initially at a radius of 200mm. The arms of the bell crank lever are 110mm vertically and 150mm horizontally Find i) The initial compressive force on the spring if the speed for an initial ball radius of 200mm is 240 rpm and ii) the stiffness of the spring required to permit a sleeve movement of 4mm on a fluctuation of 7.5% in the engine speed. [14M]

Or

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6 a) Analyze the gyroscopic effect of precession motion on the stability of motor car in detail. [7M]

b) The lengths of the upper and lower arms of a Porter governor are 200mm and 250mm respectively. Both the arms are pivoted on the axis of the rotation. The central load is 150N, the weight of each ball is 20N and the friction of the sleeve together with the resistance of the operating gear is equivalent to a force of 30N at the sleeve. If the limiting inclinations of the upper arms to the vertical are 30° and 40°, determine the range of speed of the governor. [7M]

UNIT-IV

7 a) Explain terms i) Variations in tractive effort ii) Swaying couple iii) Hammer blow as applied to locomotive balancing. [8M]

b) Why balancing of rotating parts necessary for high speed engines? [6M]

Or

8 A single cylinder horizontal engine runs at 120 r.p.m. The length of stroke is 400 mm. The mass of the revolving parts assumed concentrated at the crank pin is 100 kg and mass of reciprocating parts is 150 kg. Determine the magnitude of the balancing mass required to be placed opposite to the crank at a radius of 150mm which is equivalent to all the revolving and 2/3rd of the reciprocating masses. If the crank turns 300 from the inner dead centre, find the magnitude of the unbalanced force due to the balancing mass. [14M]

UNIT-V

9 a) Explain about free Vibration of spring mass system. [7M]

b) A shaft of 10cm diameter and 100cm long is fixed at one end and other end carries a flywheel of mass 80Kg. Taking young's modules for the shaft material as $2x10^6$ Ks/cm^2. Find the natural frequency of longitudinal and transverse vibrations? [7M]

Or

10 a) Analyze the vibration isolation. [5M]

b) A shaft 50mm diameter and 3m long. It is simply supported at the ends and carries three masses 100Kg, 120Kg and 80Kg at 1.0mm, 1.75m and 2.5m respectively from the left support. Taking $E=20GN/m^2$. Find the frequency of transverse vibrations using Rayleigh's method. [9M]

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Code No:R2022032 **R20** **SET - 4**

II B. Tech II Semester Regular Examinations, June/July - 2022

DYNAMICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours **Max. Marks: 70**

Answer any **FIVE** Questions each Question from each unit

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UNIT-I

1 a) Name different types of dynamometers?Explain function of prony brake dynamometer. [7M]

b) Find the power lost in friction assuming i) uniform pressure and ii) uniform wear when a vertical shaft of 100 mm diameter rotating at 150 rpm rests on a flat end foot step bearing. The co-efficient of friction is equal to 0.05 and shaft carries a vertical load of 15 kN. [7M]

Or

2 A simple band brake is operated by a lever of length 450 mm. The brake drum has a diameter of 600 mm, and the brake band embraces 5/8th of the circumference. One end of the band is attached to the fulcrum of the lever while the other end is attached to a pin on the lever 120 mm from the fulcrum. The effort applied to the end of the lever is 2 kN, and the coefficient of friction is 0.30. Find the maximum braking torque on the drum. [14M]

UNIT-II

3 A Punching machine makes 20 working strokes per minute, and is capable of punching 20 mm diameter hole in a 15 mm thick steel plate having an ultimate shear strength of 240 MPa. The punching operation takes place during 1/10 th of a revolution of the crankshaft. Estimate the power required for the driving motor, assuming a mechanical efficiency of 95 %. Also determine the size of the rim of the flywheel having width equal to twice the thickness. The flywheel is to revolve 10 times the speed of the crankshaft. The fluctuation of speed is 10 %. Assume the flywheel to be made of cast iron having working stress of 6 MPa and density 7300 kg/m^3. The diameter of the flywheel should not exceed 1.5 m. Neglect the effect of arms and hub. [14M]

Or

4 a) An engine flywheel has mass of 6.5 tonnes, and the radius of gyration is 2 m. If the maximum and minimum speeds are 120 rpm and 118 rpm respectively, find the maximum fluctuation of energy. [7M]

b) Explain the dynamic force analysis of four bar mechanism. [7M]

UNIT-III

5 a) Discuss the sensitiveness, isochronism and hunting of governers? [7M]

b) Porter governor has equal arms each 250mm long and pivoted on the axis of rotation. Each ball has a mass of 5Kg and the mass of the central load on the sleeve is 25Kg. The radius of rotation of the ball is 150mm when the governor begins to lift and 200mm when the governor is at maximum speed. Find the maximum and minimum speeds and range of speed of the governor. [7M]

Or
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6 a) Explain the effect of precession motion on the stability of moving vehicles such as aero planes. [5M]

b) A rear engine automobile is travelling along a curved track if 120m radius. Each of the four wheels has a moment of inertia of 2.2 kg/m^2 and an effective diameter of 600mm. The rotating parts of the engine have a moment of inertia of 1.25kg.m^2. The gear ratio of the engine to the back wheel is 3.2. The engine axis is parallel to the rear axle and the crank shaft rotates in the same sense as the road wheels. The mass of the vehicle is 2050kg and the centre of the mass is 520mm above the road level. The width of the track is 1.6m. What will be the limiting speed of the vehicle if all the four wheels maintain contact with the road surface? [9M]

UNIT-IV

7 a) Define and explain the term 'Balancing of Rotating Masses'. What will be the harm if the rotating parts of high speed engine are not properly balanced? [6M]

b) Four masses A, B, C, D revolve at equal radii and are equally spaced along a shaft. The mass B is 7kg and the radii of C and D make angles of 90^0 and 240^0 respectively with the radius of B. Find the magnitude of the masses A, C, and D and the angular position of A so that the system may be completely balanced. [8M]

Or

8 a) Four weights A, B, C and D revolve at equal radius and are equally spaced along a shaft. The weight B Weighs 70N and the radii of C and D makes angles of 90^0 and 220^0 respectively with the radius of B. Find the magnitude of weights A, C, and D. [8M]

b) Derive expressions for these for two cylinders uncoupled locomotive balancing? [6M]

UNIT-V

9 a) A shaft 12mm diameter rotates in spherical bearings with a span of 0.9m and carries a disc of mass 10 kg midway between bearings Neglecting the mass of the shaft, determine its deflection in terms of the speed of rotation in radians per second if the mass centre of the disc is 0.2mm out of the centre. The young modulus for the material of shaft is 200 kN/mm^2. [7M]

b) Analyze the torsional vibrations of two and three rotor systems. [7M]

Or

10 a) Explain vibrations of beams with concentrated and distributed loads. [6M]

b) A shaft of 100 mm diameter and 1 m long is fixed at one end, and the other end carries a flywheel of mass 1 tonne. The radius of gyration of the flywheel is 0.5 m. Find the frequency of torsional vibrations, if the modulus of rigidity of the shaft material is 80 GN/m^2. [8M]

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