Code No: **R1631031** **R16** SET - 1

III B. Tech I Semester Supplementary Examinations, August - 2021

DYNAMICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

~~~~~~

PART –A **(14 Marks)**

1. a) Discuss the effect of precession motion on the stability of moving vehicles. [2M]
   b) Describe the film lubrication. [2M]
   c) Define the fluctuation of energy. [2M]
   d) Discuss the spring loaded governors with an application. [3M]
   e) What do you mean by force balancing of linkages? How is it achieved? [3M]
   f) Describe the vibration Isolation. [2M]

PART –B **(56 Marks)**

2. a) Explain in detail, what way the gyroscopic couple affects the motion of an aircraft while taking a turn? [7M]
   b) Explain the static and dynamic force analysis of planar mechanisms. [7M]

3. a) Describe the operation of dynamometers with a neat sketch. [7M]
   b) A band and block brake has a drum of 1.0 m diameter and is fitted with 24 blocks, each having a contact angle of 10^0. The radial thickness of each block, measured from centre line of the band to the rim of the wheel is 70 mm. The band is designed to sustain a maximum force of 2000 N, The lever is arranged with l=800 mm, a= 100mm and b=80 mm. Calculate the force P required to be applied at the end of the lever if μ =0.4. Calculate the power loss due to friction if drum rotates at 240 rpm. [7M]

4. a) Describe the graphical method of considering the inertia of the connecting rod of a reciprocating engine. [7M]
   b) The turning moment diagram of a four-stroke engine is assumed to be represented by four triangles, the areas of which from the line of zero pressure are Suction stroke=520mm^2, Compression stroke= 1400mm^2, Expansion stroke=5200 mm^2, Exhaust stroke=720mm^2. Each mm^2 of area represents 4 Nm of energy. If the resisting torque is uniform, determine the mass of rim of a flywheel to keep the speed between 115 and 312 rpm when the mean radius of the rim is to be 1.25 m. [7M]

|''|''|||''|'''|||'|
~~~~~~

5. a) Explain the Hartnell and Hartung with auxiliary springs. [7M]
   b) In a porter governor, each of the four arms is 300 mm long. The upper arms are pivoted on the axis of the sleeve, whereas the lower arms are attached to the sleeve at a distance of 35 mm from the axis of rotation. Each ball has a mass of 8 kg and the load on the sleeve is 50 kg. Determine the range of speed of the governor for extreme radii of rotation of 325 mm and 340 mm. [7M]

6. a) Explain the balancing of V engine, and derive its equation. [7M]
   b) Show how the reciprocating parts of a single cylinder engine may be completely balanced, so far as primary and secondary effects are concerned, by means of revolving balance weights? [7M]

7. a) Explain the three rotor vibratory system and find the ratio of their amplitudes. [7M]
   b) A vibratory body of mass 150 kg supported on springs of total stiffness 1050 kN/m has a rotating unbalance force of 525 N at a speed of 6000 rpm. If the damping factor is 0.3, Determine: [7M]
      i) the amplitude caused by the unbalance and its phase lag.
      ii) the transmissibility and
      iii) the actual force transmitted and its phase angle.

*****

|''|''|||''|''|||'|

III B. Tech I Semester Regular/Supplementary Examinations, March – 2021

DYNAMICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

~~~~~~

PART –A **(14 Marks)**

1. a) Define spinning. [2M]
b) Write about boundary friction. [2M]
c) What is meant by fluctuation of energy? [2M]
d) Write about sensitiveness. [3M]
e) Differentiate between primary and secondary balancing. [3M]
f) List the types of damping. [2M]

PART –B **(56 Marks)**

2. A racing car weighs 20 kN. It has a wheel base of 2 m, track width of 1 m and height of C.G. 300 mm above the ground level and lies midway between the front and rear axle. The engine flywheel rotates at 3000 rpm clockwise when viewed from the front. The moment of inertia of the flywheel is 4 kg-m^2 and moment of inertia of each wheel is 3 kg-m^2. Find the reactions between the wheels and the ground when the car takes a curve of 15 m radius towards right at 30 km/hr, taking into consideration the gyroscopic and the centrifugal effects. Each wheel radius is 400 mm. [14M]

3. a) A cone clutch is used for transmitting a torque of 3x10^6 N.M. The mean diameter is 20 mm and the semi cone angle is 12^0. The coefficient of friction is 0.25 and the normal pressure at the mean radius must not exceed 1.4x10^5 N/m^2. Calculate the necessary width of the contact surface. Also find the axial force needed to hold the clutch surface together. [9M]
b) Describe the working of rope brake dynamometer with a neat diagram. [5M]

4. The turning moment requirement of a machine is represented by the equation T=(1000 + 500 sin2θ - 300 cos2θ) N-m, where θ is the angle turned by the crankshaft of the machine. If the supply torque is constant, determine: [14M]
i) The moment of inertia by the flywheel. The total fluctuation of speed is not to exceed one percent of the mean speed of 300 rpm.
ii) Angular acceleration of the flywheel when the crankshaft has turned through 45^0 from the beginning of the cycle.
iii) The power required to drive the machine.

5. In a spring loaded Hartnell type of governor, the mass of each ball is 4 kg and the lift of the sleeve is 50 mm. The governor begins to float at 240 rpm, when radius of the ball path is 110 mm. The mean working speed of the governor is 20 times the range of the speed when friction is neglected. The lengths of the ball and roller arms of the bell-crank lever are 120 mm and 100 mm respectively. The pivot centre and the axis of governor are140 mm apart. Determine the initial compression of the spring, taking in to consideration of arms. [14M]
~~~~~~

6. a) Describe about locomotive balancing with appropriate examples. [6M]
   b) A, B, C and D are four masses carried by a rotating shaft at radii 100 mm, l50 mm, 150 mm and 200 mm respectively. The planes in which masses rotate are spaced at 500 mm apart and the magnitude of the masses B, C and D are 9 kg, 5 kg and 4 kg respectively. Find the required mass A and the relative angular settings of the 4 masses so that the shaft shall be in complete balance. [8M]

7. a) A shaft 50 mm diameter and 3 m long. It is simply supported at the ends and carries three masses 100 Kg, 120 Kg and 80 Kg at 1.0 m, 1.75 m and 2.5 m respectively from the left support. Taking E=20 GN/m^2. Find the frequency of transverse vibrations using Rayleigh's method. [9M]
   b) Explain about free vibration of spring mass system. [5M]

*****

||''|''||''||''''''|

Code No: R1631031 **R16** SET - 2

III B. Tech I Semester Regular/Supplementary Examinations, March – 2021

DYNAMICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

~~~~~~

PART –A **(14 Marks)**

1\. a) Define precession. [2M]
b) Write about film lubrication. [2M]
c) State the applications of fly wheels. [2M]
d) Write about watt governor. [3M]
e) What is meant by hammer blow? [3M]
f) Write about whirling of shafts. [2M]

PART –B **(56 Marks)**

2\. The turbine rotor of a ship has a mass of 20 tonnes and a radius of gyration of 0.75 m. Its speed is 2000 rpm. The ship pitches 6^0 above and below the horizontal position. One complete oscillation takes 18 seconds and the motion is simple harmonic. Determine: i) The maximum couple tending to shear the holding down bolts of the turbine; ii) The maximum angular acceleration of the ship during pitching; iii) The direction in which the bow will tend to turn while rising, if the rotation of the rotor is clockwise when looking from rear. [14M]

3\. A band and block brake having 12 blocks, each of which subtends 15^0 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]

4\. a) A machine requires a torque of (1500+200sinθ) 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+250sinθ) N-m. The flywheel and other rotating parts have a mass 300 kg at radius of gyration 200 mm. 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. [8M]
b) Explain the dynamic force analysis of slider crank mechanism. [6M]

5\. a) Calculate the minimum speed of a Proell governor, which has equal arms each 200 mm and are pivoted on the axis of rotation. The mass of each ball is 4 kg and the central mass on the sleeve is 20 kg. The extension arms of the lower links are each 60 mm long and parallel to the axis when the minimum radius of the ball is 100 mm. [9M]
b) Explain about spring loaded governors. [5M]
~~~~~~

6. 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 45^0 from the inner dead centre, find the magnitude of unbalance force due to the balance mass. [14M]

7. 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 $2x10^6$ kg/cm^2, find the natural frequency of longitudinal and transverse vibrations. [7M]

   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. [7M]

*****

||''|''||''||''''''|

III B. Tech I Semester Regular/Supplementary Examinations, March – 2021

DYNAMICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

~~~~~~

PART –A (14 Marks)

1. a) Define gyroscopic couple. [2M]
b) State the types of brakes. [2M]
c) Write the importance of turning moment diagrams. [2M]
d) Briefly explain isochronism. [3M]
e) What is meant by swaying couple? [3M]
f) Write about critical speeds of shafts. [2M]

PART –B (56 Marks)

2. 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 300 mm. 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]

3. a) Describe 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) Describe with a neat sketch the working of a single plate friction clutch. [6M]

4. The equation of the turning moment diagram for a three-crank engine is given by T(N-m)=25000-7500sin3θ, 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]

5. The lengths of the upper and lower arms of a Porter governor are 200 mm and 250 mm respectively. Both the arms are pivoted on the axis of the rotation. The central load is 150 N, the weight of each ball is 20 N and the friction of the sleeve together with the resistance of the operating gears is equivalent to a force of 30 N at the sleeve. If the limiting inclinations of the upper arms to the vertical are 300 and 400, determine the range of speed of the governor. [14M]

6. 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 12 cm and the length of each connecting rod 20 cm. The mass of the reciprocating parts per cylinders is 2 Kg. 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]
~~~~~~

7. 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. [6M]
   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. [8M]

*****

||''|''||''||''''''|

Code No: R1631031 **R16** SET - 4

III B. Tech I Semester Regular/Supplementary Examinations, March – 2021

DYNAMICS OF MACHINERY

(Mechanical Engineering)

Time: 3 hours Max. Marks: 70

Note: 1. Question Paper consists of two parts (**Part-A** and **Part-B)**
2. Answer **ALL** the question in **Part-A**
3. Answer any **FOUR** Questions from **Part-B**

~~~~~~

PART –A (14 Marks)

1. a) Differentiate between spinning and precession. [2M]
   b) State the types of dynamometers. [2M]
   c) Write about crank effort. [2M]
   d) What is meant by hunting of governors? [3M]
   e) Define variation of tractive effort. [3M]
   f) Write about torsional vibrations. [2M]

PART –B (56 Marks)

2. 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 ships. [5M]

3. a) 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 240^0. The coefficient of friction is 0.25. Find the torque which can be 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. [8M]
   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. [6M]

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 240 rpm. [8M]
   b) Describe about angular velocity and acceleration of connecting rod. [6M]

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

||''|''||''||''''''|
~~~~~~

6. a) Four weights A, B, C and D revolve at equal radius and are equally spaced along a shaft. The weight B weighs 70 N 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) Why balancing of rotating parts necessary for high speed engines? Explain. [6M]

7. Two rotors A and B are attached to the ends of a shaft 600 mm long. The mass of the rotor A is 400 Kg and its radius of gyration is 400 mm. The corresponding values of rotor B are 500 Kg and 500 mm respectively. The shaft is 80 mm diameter for the first 250 mm, 120 mm diameter for next 150 mm and 100 mm diameter for the remaining length. Modulus of rigidity of the shaft material is $0.8x10^5$ MN/m^2. Find the position of the node, the frequency of torsional vibrations. [14M]

*****

||''|''||''||''''''|