Anna University Exams Nov / Dec 2017 – Regulation 2013
Rejinpaul.com Unique Important Questions – 5th Semester BE/BTECH
ME6505 Dynamics of Machines

Important: DOM subject is a problematic subjects. Students are advised to practice related model problem

Unit I

1. **A vertical petrol engine with cylinder of 150mm diameter and 200mm strokes has a connecting rod of 350mm long. The mass is 1.6kg and the engine speed is 1800 rpm. On the expansion stroke with crank angle 30° from TDC, the gas pressure is 750KPa. Determine the net thrust on the piston**
2. **The radius of gyration of a fly wheel is 1 meter and fluctuation of speed is not to exceed 1% of the mean speed of the flywheel. If the mass of the flywheel is 3340kg and the steam develops 150KW at 135rpm, then find 1.Maximum fluctuation of energy 2. Coefficient of fluctuation of energy**
3. **The length and connecting rod of a horizontal reciprocating engine are 200mm and 1meter respectively. The crank is rotating at 400rpm.When the crank has turned 30° from the inner dead center, the difference of pressure between cover end and piston rod is 0.4 N/mm^2. If the mass of the reciprocating parts is 100Kg and a cylinder bore is 0.4meters.Calculate (i)Inertia force (ii) Force on piston (iii) Piston effort (iv) Thrust on the side of the cylinder walls (v) Thrust in the connecting rod (vi)Crank effort**
4. **The length of crank and connecting rod of a horizontal reciprocating engine are 100mm and 500mm respectively. The crank is rotating at 400rpm.When the crank has turned 30° from the IDC, find analytically1.Velocity of piston 2.Acceleration of piston 3. Angular velocity of connecting rod 4. Angular acceleration of connecting rod**
5. **For reciprocating engine, derive the expression for (i)Velocity and acceleration of the piston (ii)Angular velocity and angular acceleration of the connecting rod**
6. **A horizontal gas engine running at 210rpm has a bore of 220mm and a stroke of 440mm. The connecting rod is 924mm long the reciprocating parts weight 20kg.When the crank has turned through an angle of 30° from IDC, the gas pressure on the cover and the crank sides are 500KN/m^2 and 60KN/m^2 respectively. Diameter of the piston rod is 40mm.Determine, 1. Turning moment on the crank shaft 2.Thrust on bearing 3. Acceleration of the flywheel which has a mass of 8kg and radius of gyration of 600mm while the power of the engine is 22KW**
7. **A single cylinder vertical engine has a bore of 300mm and a stroke of 400mm.The connecting rod is 1000mm long. The mass of the reciprocating parts is 140kg.On the expansion stroke with the crank at 30° from the top dead center, the gas pressure is 0.7MPa.If the runs at 250rpm, determine; 1. Net force acting on the piston 2.resultant load on the gudgeon pin 3.Thrust on cylinder walls 4.The speed above which other things remaining same, gudgeon pin loads would be reversed in direction**
8. **The torque delivered by a two stroke engine is represented by T= (1000+300sin2Θ-500cos2Θ)N-m where Θ is the angle turned by the crank from the IDC. The engine speed is 250rpm.The mass of the flywheel is 400kg and radius of gyration 400mm.Determine,(i)the power developed (ii)the total percentage fluctuation of speed (iii)the angular acceleration of flywheel when the crank has rotated through an angle of 60° from the IDC. (iv) The maximum angular acceleration and retardation of the flywheel**

UNIT – II

1. **A shaft is rotating at a uniform angular speed. Four masses M_1, M_2, and $M_3$and M_4 of magnitudes 300kg, 450kg, 360kg, 390kg respectively are attached rigidly to the shaft. The masses are rotating in the same plane. The corresponding radii of rotation are 200mm, 150mm, 250mm and 300mm respectively. The angle made by these masses with horizontal are 0°,45°, 120°and 255°respectively. Find,(i) the magnitude of balancing mass (ii) the position of balancing mass if its radius of rotation is 200mm**

2. Four masses M_1, M_2, M_3, and M_4 are 200kg, 300kg, 240kg and 260kg respectively. The corresponding radii of rotation are 0.2m, 0.15m, 0.25m and 0.3m respectively and the angle between successive masses45°, 75°, and135°.Find the position and magnitude of balance mass required if its radius of rotation is 0.25m
3. A shaft caries four rotating masses A, B, C and D which are completely balanced. The masses B, C and Dare 50kg, 80kg and 70kg respectively. The masses C and D make angles of 90° and 195° respectively with mass B in the same sense. The masses A,B,C and D are concentrated at radius 75mm,100mm,50mm and 90mmrespectively.The plane of rotation of masses B and C are 250mm apart. Determine (i) the magnitude of mass A and its angular position (ii) the position of planes A and D.
4. A four cylinder vertical engine has cranks 150mm long. The plane of rotation of the first, second and fourth cranks are 400mm,200mm and 200mm respectively from that of the third crank and their reciprocating masses are 50kg,60kg and 50kg respectively. Find the mass of the reciprocating parts for the third cylinder and relative angular position of the cranks in order that the engine may be in complete balance
5. Derive the following expression of effects of partial balancing in two cylinder locomotive engine (i) Variation of attractive force (ii) Swaying couple (iii) Hammer blow
6. Four masses A, B, C and D revolves at equal radii and equally spaced along a shaft. The mass B is 7kg and the radii of C and D make angle s of 90° and 240 °respectively with the radius of B. Find the magnitude of masses A,C and D and angular position of A . So that the system may be completely balanced

Unit III

1. Derive an expression for the natural frequency of the free longitudinal vibration by (i)Equilibrium method (ii) Energy method (iii)Rayleigh's method
2. In a single degree of damped vibration system a suspended mass of 8kg makes 30 oscillations in 18 seconds. The amplitude decreases in 18 seconds. The amplitude decreases to 0.25 of the initial value after 5 oscillations. Determine (i) the spring stiffness (ii) logarithmic decrement (iii) damping factor (iv)Damping coefficient
3. A vibrating system consists of a mass of 8kg, spring of stiffness 5.6N/m and dashpot of damping coefficient of 40N/m/s. Find,(i)Critical damping coefficient (ii) the damping factor (iii) the natural frequency of damped vibration (iv) the logarithmic decrement(v) the ratio of two consecutive amplitude (vi)the number of cycle after which the original amplitude is reduced to 20 percent
4. Between a solid mass of _kg and the floor are kept two slabs of isolates, natural rubber and felt, in series. The natural rubber slab has a stiffness of 3000N/m and equivalent viscous damping coefficient of 100 N-sec/m. The felt has a stiffness of 12000N/m and equivalent viscous damping coefficient of 330Nsec/m. Determine undamped and the damped natural frequencies of the system in vertical direction.
5. A steel shaft 100mm in diameter is loaded and support in shaft bearing 0.4m apart. The shaft carries three loads: first mass 12kg at the centre, second mass 10kg at a distance 0.12m from the left bearing and third mass of 7kg at a distance 0.09m from the right bearing. Find the value of the critical speed by using Dunker ley's method. $E=2X1011N/m^2$
6. The barrel of a large gun recoils against a spring on firing. At the end of the firing, a dashpot is engaged that allows the barrel to return to its original position in minimum time without oscillation. Gun barrel mass is 400kg and initial velocity of recoils 1m.Determine spring stuffiness and critical damping coefficient of dashpot
7. An instrument vibrates with a frequency of 1Hz when there is no damping. When the damping is provided, the frequency of damped vibration was observed to be 0.9Hz. Find, (i) damping factor (ii) logarithmic decrement

Unit IV

1. A mass of 50kg is supported by an elastic structure of total stiffness 20KN/m.The damping ratio of the system is 0.2.A simple harmonic disturbing force acts on the mass and at any time 't seconds, the force is 60sin10t Newtons.Find amplitude of the vibration and phase angle caused by the damping
2. A mass of 10kg is suspended from one end of a helical spring, the other end being fixed. The stiffness of the spring is10N/mm. The viscous damping causes the amplitude to decreases to one-tenth of the initial value

in four complete oscillations. If a periodic force of 150cos50t N is applied at the mass in the vertical direction .Find the amplitude of the forced vibrations? What is its value of resonance?

3. A body having a mass of 15kg is suspended from a spring which deflects 12mm under the weight of the mass. Determine the frequency of the free vibrations. What is the viscous damping force needed to make the motion a periodic at a speed of 1mm/s?If, when damped to this extend a disturbing force having a maximum value of 100N and vibrating at 6Hz is made to act on the body, determine the amplitude of the ultimate motion.
4. A single cylinder engine has an out of balance force of 500N at an engine speed of 30rpm.The total mass of engine is 150kg and its carried on a set of total stiffness 300N/cm. (i) Find the amplitude of steady motion of the mass and maximum oscillating force transmitted to the foundation. (ii)If a viscous damping is interposed between the mass and the foundation the damping force 1000N at 1m/s of velocity, find the amplitude of force damped oscillation of the mass and its angle of lag with disturbing force
5. The mass of an electric motor is 120kg and it runs at 1500rpm.The armature mass is 35kg and its centre gravity lies 0.5mm from 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) the stiffness of the spring (ii) the dynamic force transmitted to the base at the operating speed. (iii) Natural frequency of system
6. A machine 100kg has a 20kg rotor with 0.5mm eccentricity. The mounting spring have s=85x103. The operating speed is 600rpm and the unit is constrained to move vertically. Find (i) Dynamic amplitude of machine (ii) the force transmitted to the support

Unit V

1. A porter governor has equal arms each 250mm long and pivoted on the axis of rotation. Each ball has a mass of 5kg and mass of the central load on the sleeve is 25kg.The radius of rotation of the ball is 150mm when governor is at maximum speed. Find the maximum and minimum speed and range of speed of the governor
2. The length of the upper and lower arms of a porter governor are 200mm and 250mm respectively. Both the arms are pivoted on the axis of rotation. The central load is 150N, the weight of the 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° taking friction in to account. Find the range of speed of the governor.
3. A hartnell governor having a central sleeve spring and two right angled bell crank lever operates between 290rpm and 310rpm for a sleeve lift of 15mm.The sleeve and ball arms are 80mm and 120mm repectively.The levers are pivoted at 120mm from the governoraxis and mass of the ball is 2.5kg.The ball arms are parallel at lowest equilibrium speed.Determine (i) load on the spring at maximum and minimum speeds and (ii) Stiffness of the spring
4. Calculate the rage of speed of a porter governor which has equal arms of each 200mm long and pivoted on the axis of rotation .The mass of each ball is 4kg and the central load of the sleeve is 20kg.The radius of rotation of the ball is 100mm when the governor being to lift and 130mm when the governor is at maximum speed
5. The controlling force in a spring controlled governor is 1500N when radius of rotation is 200mm and 887.5N when radius of rotation is 130mm.The mass of each ball is 8kg.If the controlling force curve is a straight line, then find (i) Controlling force at 150mm radius of rotation (ii) Speed of the governor at 150mm radius.(iii)Increase in initial tension so that governor is isochronous. (iv) Isochronous speed

6. **In a spring controlled governor, the controlling force curve is a straight line. When the balls are 400mm apart, the controlling force is 1200N and when 200mm apart, the controlling force is 450N.Determine the speed at which the governor runs when the balls are 250mm apart. When initial tension on the spring would be required for isochronisms and what would be the speed. Take mass of each ball to be 10kg**
7. **The turbine rotor of a ship has a mass of 20 tonnes and a radius of gyration 0.75.Its speed is 2000rpm.The ship pitches 6° 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 bolt 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, if the rotation of the rotor is clockwise when locking from rear**
8. **The rotor of a turbine yatch rotates at 1200rpm clockwise when viewed from stern. The rotor has a mass of 750 kg and radius of gyration of 250mm.Find the maximum gyroscopic couple transmitted tothe hull when yacht pitches with a maximum angular velocity of 1 rad/s.What is the effect of this couple?**