COMPREHENSIVE EXAMINATION

Max. Marks: 80   Duration: 3 Hrs.
Weightage: 40%   Date: 24-05-2010

- Answer all questions.
- Marks are shown in brackets against each question.
- Draw suitable sketches for all the questions, wherever necessary.
- Assume any missing data may be assumed suitably.

Question 1

The lengths of the connecting rod and crank of a horizontal steam engine are 0.3 m. and 1.2 m respectively. The diameter of cylinder is 0.3m and mass of reciprocating parts is 160 kg. When the crank is turned through 30^0 from the the inner dead centre find the acceleration of piston using Klein's construction. The average frictional resistance to motion is 550 N and net effective steam pressure on the piston is 0.5 MPa. Find the Piston effort, force along connecting rod, thrust on cylinder walls, thrust on bearings crankpin effort and torque on crank shaft   [10M]

Question 2

The connecting rod of length 500 mm is 15 kg. The distance of C.G of the rod is 200 mm from the big end. The radius of gyration of the connecting rod is 140 mm about an axis passing through C.G. If the angular acceleration of connecting trod is 150 rad/s^2, find the inertia torque which must be applied to keep connecting rod in equilibrium.   [10M]

Question 3

The turning moment diagram of for a multi-cylinder engine has been drawn to a vertical scale of 1mm = 650 Nm and a horizontal scale of 1 mm = 6^0.The areas above and below the mean torque line are -30, +382, -260, +310, -306, +248, -380, +265 and -229 mm^2. The fluctuation of speed is limited to 1.8% of mean speed which is 900 rpm.Determine mass of flywheel if its radius is 1 m.

[10M]

Question 4

The mass of each ball of a Proell governor is 9.6 kg and the mass on the sleeve is 90 kg. Each of arm is 305 mm long. The upper arms are pivoted on the axis of rotation whereas the lower arms are attached to a sleeve at a distance of 38 mm from the axis. The mass of ball is attached to the extension of the lower arms which are 102 mm long. The minimum and maximum radii of governor are 165 mm and 216 mm. Assuming that he extensions of lower arms are parallel to the governor axis at the minimum radius, find the corresponding equilibrium speeds.   [10M]

Question 5

A single cylinder reciprocating engine has the following data:
Length of the connecting rod: 700 mm; speed: 140 rpm; stroke: 300mm;
Mass of reciprocating parts: 50 kg; mass of revolving parts: 30 kg.
If 70% of reciprocating parts and all the revolving parts are to be balanced, then find
Vartiation in tractive effort and swaying couple if the distance between cylinder centre lines is 300 mm. Derive the formulae used.   [10M]

Question 6
A ship has a turbine rotor of mass 5 tonnes and radius of gyration 600 mm. It
rotates at 1500 rpm in clock-wise sense when looking from the stern. Determine the gyroscopic
couple   under the following conditions:
(i) The ship steers to the left at a radius of 100 m with a speed of 2 km/hr.
(ii) The ship pitches with SHM with amplitude of 8 degrees and time periods 12 sec.
Derive the formulae used.   [10M]

Question 7
Derive an expression used for finding natural frequency of the shaft fixed at upper end and carries
a mass **m** at the bottom end with stiffness **k** and also find the natural frequency of transverse vibration
of a simply supported shaft which is of 20 mm diameter and of length 6m. The shaft carries a load of
10 N at its centre. Take Young's modulus of the material of the shaft is 200 GN/m^2.   [10M]

Question 8
Explain briefly logarithmic decrement and determine its value for a vibrating system, which consists
of mass of 3.5 kg, a spring of stiffness 2.5 N/mm and damper of damping coefficient 0.018 N/mm/s.
Derive the formula used   [10M]

T E S T I I (OPEN BOOK)

Max. Marks: 20   Duration: 50 Min.
Weightage: 20%   Date: 25-04 -2010

NOTE:
- Answer all questions.
- Marks are shown in brackets against each question.
- Assume missing data suitably if any.
- Prescribed text book and hand-written class notes are only allowed.

Question1

Determine the range of speed of a PORTER governor which has all four arms 250 mm long. The upper arms are attached to the axis of rotation and lower arms are attached to the sleeve at a distance of 30 mm from the axis. The mass of each ball is 6 kg and central mass on the sleeve is 60 kg. The extreme radii of rotation are 150 mm and 200 mm. Draw the free hand sketches of governor.   [6 M]

Question 2

Calculate the minimum speed of a PROELL governor, which has equal arms each 200 mm and pivoted on the axis of rotation. The mass of each ball is 5 kg and central mass on the sleeve is 25 kg. The extension arms of lower links are each 60 mm long and parallel to the axis when minimum radius of ball is 100 mm. Draw the free hand sketches of governor.   [4 M]

Question 3

A shaft carries four masses A, B, C and D of magnitudes 300 kg, 450 kg, 600 kg and 300 kg respectively and revolving at radii 120 mm, 105 mm, 90 mm and 120 mm in planes measured from the plane A at 350 mm, 600 mm and 1050 mm. The angles between the cranks measured counter-clockwise are A to B 45^0, B to C 70^0 and C to D 120^0. The balancing masses are to be balanced in planes X and Y.
The distance between the planes A and X is 150 mm, between X and Y is 600 mm, and between Y and D is 300 mm. If both the balancing masses revolve at same radius of 150 mm, find their magnitude and angular positions using graphical method.   [10 M]

TEST I

Max. Marks: 50   Duration: 50 Min.
Weightage: 25%   Date: 14-03 -2010

NOTE:
- **Answer all questions.**
- **Marks are shown in brackets against each question.**
- **Assume suitable missing data if any.**

Question 1

(a) Draw the free hand sketches of various kinematic pairs with their degrees of freedom. **[4M]**
(b) A connecting rod of length 250 mm has a mass of 2 kg and moment of inertia
22,000 kg mm^2 about its centre of gravity. Centre of gravity is located at a distance of 70 mm
From the crank end. If the connecting rod is replaced by two masses at the two ends, find the
the masses and equivalent length for the dynamically equivalent system.   **[8M]**

Question 2

(a) Briefly explain D'Alembert's principle.   **[2M]**
The crank shaft of a vertical reciprocating engine is rotating clock-wise direction with a
constant angular velocity of 50 rad/s. The lengths of crank and connecting rod are 120 mm
and 360 mm respectively. Find the velocities and acceleration of crank shaft, connecting rod
and piston when the crank has turned through 45^0 from inner dead centre. Draw Klein's
velocity and acceleration diagrams to find the velocities and accelerations.   **[12M]**

Question 3

A single cylinder four stroke vertical engine develops 70 kW power at a mean speed of
600 r.p.m. The lengths of crank and connecting rod are 400 mm and 2 m respectively.
The masses of reciprocating parts is 160 kg. Find the force on connecting rod and crank pin
effort when the crank has turned through 45^0 from the TDC and the piston is moving
downwards. The cylinder has a bore of 300 mm and the gas pressure is 0.8 MPa. Draw the
free hand sketch, showing all forces.   **[12M]**

Question 4

(a) What is the function of a flywheel?   **[2M]**
(b) The turning moment diagram for a multi-cylinder engine has been drawn to scale of
1 mm = 320 Nm vertically and 1 mm = 35^0 horizontally. The areas above and below the mean
torque line are -26, +378, -256, +306, -302, +244, -380, +261 and -225 mm^2. The engine is
running at a mean speed of 500 r.p.m. The total fluctuation of speed is not to exceed ±1.8%
of mean speed. Find the moment of inertia of flywheel. Draw the free hand sketch of turning
moment diagram.   **[10M]**

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ME C422 DYNAMICS OF MACHINES & VIBRATIONS
II SEMESTER 2009-2010

Q U I Z I I

Max. Marks: 14   Duration: 20 Min.

Weightage: 7%   Date: 11-05-2010

- Answer all questions.
- Marks are shown in brackets against each question.

Question 1

What are primary and secondary forces?   [1M]

Question 2

Why is balancing of reciprocating masses partial?   [1M]

Question 3

What are the effects of partial balancing in locomotives?   [2M]

Question 4
A Catilever shaft of lemgth 250 mm carries a mass of 50 kg placed at free end. If
E = 200 GPa and diameter of shaft is 45 mm, find the natural frequency of transverse
vibration. **[3M]**

Question 5
Explain briefly logarithmic decrement with a neat sketch.   **[3M]**

Question 6
Explain briefly swaying couple with a neat sketch.   **[4M]**

Name:_____   **B**

ID NO:_____

QUIZ I

Max. Marks: 16   Duration: 20 Min.
Weightage: 8%   Date: 30-03-2010

- Answer all questions.
- Put √ mark in the brackets provided against the suitable answer.
- Marks are shown in brackets against each question.

Question 1 Piston effort for a Vertical engine depends on the following forces [1M]

    A Force on piston, inertia force and gravity weight.   [   ]

    B Force on piston and inertia force.   [   ]

    C Force on piston only.   [   ]

    D Ineria force only.   [   ]

Question 2   For a dynamically equivalent rigid body, its radius of gyration about the centroidal axis is   [1M]

    A Geometric mean of the distances of two masses from the centre of gravity.   [   ]

    B Harmonic mean of the distances of two masses from the centre of gravity.   [   ]

    C Arithmetic mean of the distances of two masses from the centre of gravity.   [   ]

    D Mean of the radii of gyration of two masses.   [   ]

Question 3 Crank pin effort is   [1M]

    A   Parallel to the line of stroke.   [   ]

    B   Perpendicular to the line of stroke.   [   ]

    C   Parallel to the connecting rod.   [   ]

    D   Perpendicular to the crank shaft.   [   ]

Question 4 Which of the following is considered as a dynamically equivalent system
for finding the actual torque on crank shaft?   [1M]

    A   Piston   [   ]   B   Crank shaft   [   ]

    C   Connecting rod   [   ]   D   Cylinder   [   ]

Question 5 Virtual work is the product of   [1M]

    A   Actual force and actual displacement   [   ]

    B   Virtual force and virtual displacement.   [   ]

    C   Actual force and virtual displacement   [   ]

    D   Virtual force and actual displacemrnt.   [   ]

Question 6 Which of the following is not the condition for a dynamically equivalent
Sysem?   [1M]

    A   Mass of the rigid body is equal to the sum of the two masses
at its ends.   [   ]

    B   The moments of the two masses about the centre of gravity of
rigid body must be equal.   [   ]

    C   The radii of gyration of rigid body about its centre of gravity
must be equal to the sum of radii of gyration of two masses.   [   ]

    D   The moment of inertia of the rigid body about its centre of gravity
must be equal to the sum of moments of inertia of the two masses.   [   ]

2

Question 7   If the angle of connecting rod and piston effort are 8^0 and 30 kN respectively, Find the thrust on cylinder walls [2M]

Question 8 The length of the stroke of an engine is 600 mm. If the crank pin effort is 19 kN, then the approximate on the crank shaft is [2M]

∧
torque

Question 9 The connecting rod has a radius of gyration about it centroidal axis is 600 mm. Find the equivalent length of connecting rod if one of the masses at small end is at a distance of 1 m from its centre of gravity.   [2M]

Question 10 The angle and radius of crank shaft are 40^0 and 120 mm respectively. if the correcting force at the crank pin is 80 N, then find correcting torque on the crank shaft [Take m = 4]   [2M]

Question 11 Find The net force on the piston due to a gas pressure of 800 kN/m^2 the cylinder of 1000 mm diameter is equal to   [2M]

4