GUJARAT TECHNOLOGICAL UNIVERSITY
BE - SEMESTER–V • EXAMINATION – WINTER 2013

Subject Code: 152504   **Date: 02-12-2013**

Subject Name: Dynamics of Machines & Production Engineering Drawing

Time: 10.30 am - 01.00 pm   **Total Marks: 70**

Instructions:
1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Use drawing sheet/s for graphical solution wherever specified & for drawing or sketches.**

Q.1 **(a)** What is the function of a flywheel? Explain the turning moment diagram of a four stroke cycle internal combustion engine.   **07**

(b) During a trial on steam engine, it is found that the acceleration of the piston is 36 m/s^2 when the crank has moved 30° from the inner dead centre position. The net effective steam pressure on the piston is 0.5 N/mm^2 and the frictional resistance is equivalent to a force of 600 N. The diameter of the piston is 300 mm and the mass of the reciprocating parts is 180 kg. If the length of the crank is 300 mm and the ratio of the connecting rod length to the crank length is 4.5, find analytically: **07**
(i) Reaction on the guide bars, (ii) Thrust on the crank shaft bearings, and
(iii) Turning moment on the crank shaft.

Q.2 **(a)** Define and explain the terms: Piston effort, Crank effort, Thrust on the sides of cylinder walls and Thrust on the crank shaft bearing.   **05**

(b) The crank and connecting rod lengths of an engine are 125 mm and 500 mm respectively. The mass of the connecting rod is 60 kg and its centre of gravity is 275 mm from the crosshead pin centre, the radius of gyration about centre of gravity being 150 mm. If the engine speed is 600 rpm for a crank position of 45° from the inner dead centre, determine, using Klien's construction (i) the acceleration of the piston & (ii) the magnitude, position and direction of inertia force due to the mass of the connecting rod. [Use graphical method]   **09**

OR

(b) The turning moment diagram for a petrol engine is drawn to the following scales: Turning moment, 1 mm = 5 N-m; crank angle, 1 mm = 1°. The turning moment diagram repeats itself at every half revolution of the engine and the areas above and below the mean turning moment line taken in order are 300, 680, 45, 345, 955, 275 mm^2. The rotating parts are equivalent to a mass of 38 kg at a radius of gyration of 180 mm. Determine the coefficient of fluctuation of speed when the engine runs at 1600 rpm.   **09**

Q.3 **(a)** Explain the method of balancing radial engines by 'Direct & Reverse Crank'. Also, state the condition when this method becomes applicable.   **06**

(b) A shaft carries four masses A, B, C and D of magnitude 200 kg, 300 kg, 400 kg and 200 kg respectively and revolving at radii 80 mm, 70 mm, 60 mm and 80 mm in planes measured from A at 300 mm, 400 mm and 700 mm. The angles between the cranks measured anticlockwise are A to B 45°, B to C 70° and C to D 120°. The balancing masses are to be placed in planes X and Y. The distance between the planes A and X is 100 mm, between X and Y is 400 mm and between Y and D is 200 mm. If the balancing masses revolve at a radius of 100 mm, find their magnitudes and angular positions. [Use graphical method]   **08**

Q.3 **(a)** Suppose five masses are attached to a shaft which is rotating at an angular speed of ω rad/sec. If all the masses are in the same plane, describe the analytical method of balancing these masses by a single mass only. **05**

(b) The cranks and connecting rods of a 4-cylinder in-line engine running at 1600 rpm are 60 mm and 240 mm each respectively and the cylinders are spaced 150 mm apart. If the cylinders are numbered 1 to 4 in sequence from one end, the cranks appear at intervals of 90° in an end view in the order 1-4-2-3. The reciprocating mass corresponding to each cylinder is 1.5 kg. Determine: (i) Unbalanced primary and secondary forces, if any, and (ii) Unbalanced primary and secondary couples with reference to central plane of the engine. [Use graphical method] **09**

Q.4 **(a)** Explain with neat sketches the types of free vibrations. **06**

(b) A shaft 50 mm diameter and 3 metres long is simply supported at the ends and carries three loads of 1000 N, 1500 N and 750 N at 1 m, 2 m and 2.5 m from the left support. The Young's modulus for shaft material is 200 GN/m^2. Find the frequency of transverse vibration. Use Dunkerley's method. **08**

OR

Q.4 **(a)** Derive the equation for natural frequency of free vibrations for a single spring-mass system by energy method. **05**

(b) A shaft 1.5 m in length & supported in flexible bearings at the ends carries two wheels each of 50 kg mass. One wheel is situated at the centre of the shaft and the other at a distance of 375 mm from the centre towards left. The shaft is hollow of external diameter 75 mm and internal diameter 40 mm. The density of the shaft material is 7700 kg/m^3 and its modulus of elasticity is 200 GN/m^2. Find the lowest whirling speed of the shaft in RPM, taking into account the mass of the shaft. **09**

Q.5 **(a)** A vertical square prism, base 50 mm side and height 90 mm has a face inclined at 30° to the V.P. It is completely penetrated by another square prism, base 40 mm side and axis 100 mm long, faces of which are equally inclined to the V.P. The axes of the two prisms are parallel to the V.P. and bisect each other at right angles. Draw projections of the assembly of the prisms showing the lines of intersection. **08**

(b) Draw at least six different types of bolts which prevent the rotation of bolt itself. **06**

OR

Q.5 **(a)** Draw missing lines, full or dotted, in the orthographic views of an object, shown in Figure – 1 and indicate them by the letters M.L. Support your answer by freehand sketch of the isometric view of the object, without which, no credit will be given for the answer. Assume suitable dimensions. **04**
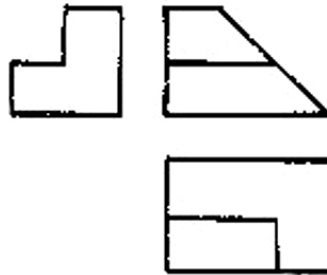

Figure – 1 [**Q.5(a)**]

(b) Figure – 2 shows two views of an object. Including side view & showing **10** cutting plane XX, draw,

 (i) Sectional front view (& mark as Section - XX)

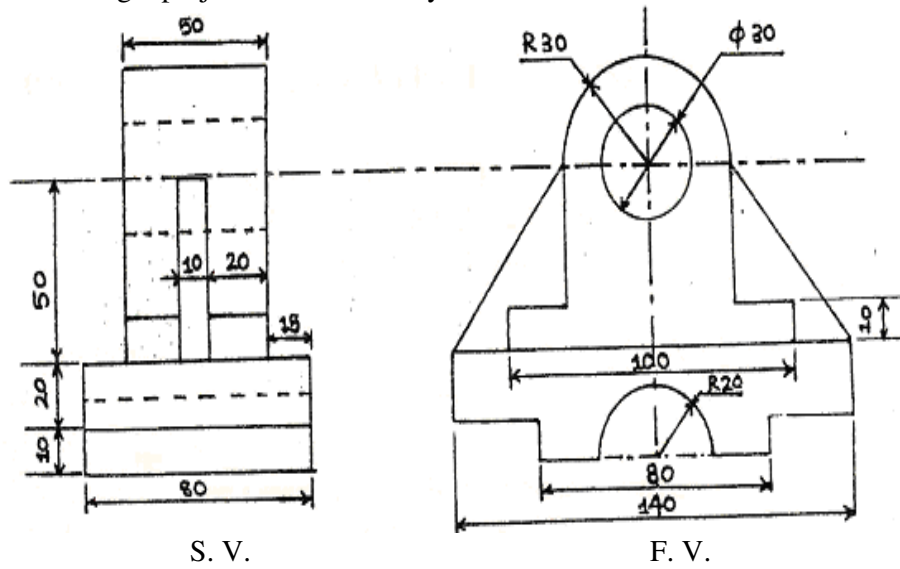(ii) Top view of the object.

Use first angle projection method only.

S. V.   F. V.

Figure – 2 [**Q.5(b)**]

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