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06ME52

Fifth Semester B.E. Degree Examination, June-July 2009
Design of Machine Elements - I

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, selecting at least TWO questions from each part.*
2. Use of design data hand book is permitted.
3. Missing data should be suitably assumed and clearly stated.

PART – A

1 a. Write brief note on general procedure used in design. **(05 Marks)**

b. Explain the following theories of failure:
i) Maximum normal stress theory. ii) Distortion energy theory. **(05 Marks)**

c. A steel rod 1.5 meter long resists an impact load of 2 kN dropped through a distance of 50mm along its axis. Limiting the maximum stress in the rod to 150 MPa, determine i) The diameter of rod required ii) Impact factor. Use E = 200 GPa. **(10 Marks)**

2 a. Explain the following:
i) Notch sensitivity ii) Stress concentration factor **(05 Marks)**

b. A bolt in an assembly is subjected to a pull of 1000N along its axis and a shear force of 500N, what will be the maximum stress induced in the bolt. If the bolt is made of SAE 1045 annealed steel, is the bolt is safe given that the diameter of bolt is 12mm. **(07 Marks)**

c. A 50mm diameter steel rod supports a 9000N load and in addition is subjected to torsional moment of 100 N-m. Determine the maximum normal and the maximum shear stresses. **(08 Marks)**

3 a. Explain endurance limit and endurance strength with the help of S.N. diagram. **(05 Marks)**

b. A hot rolled steel rod is subjected to a torsional load that varies from +330 N-m clockwise to 110 N-m counter clockwise and an applied bending moment varies from +440 N-m to –220 N-m. The rod is of uniform cross-section. Determine the required rod diameter. The material has an ultimate tensile strength of 550 MPa and a yield strength of 410 MPa. Design based on a factor of safety of 1.5. Take the endurance limit as half the ultimate strength. **(15 Marks)**

4 a. A machine component is subjected to a bending load which is completely cyclic as shown in Fig.4(a). Determine the suitable value of load W. If the maximum stress induced is not to exceed 100 N/mm^2, take σ_y = 250 N/mm^2 and σ_{end} = 200 N/mm^2. **(10 Marks)**

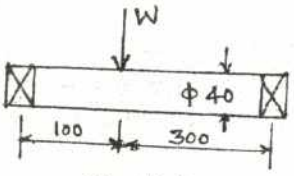

Fig.4(a)

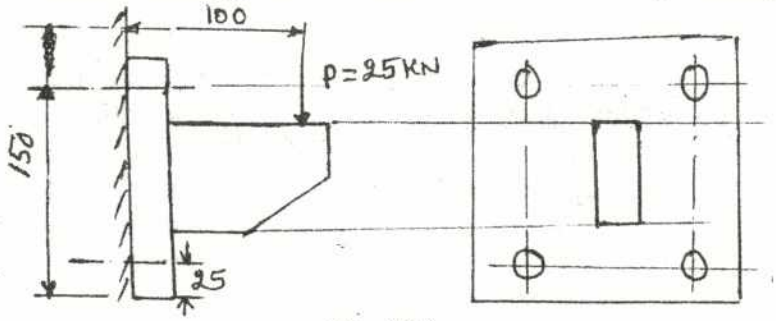

Fig.4(b)

b. A bracket is fixed to the wall by means of four bolts and loaded as shown in Fig.4(b). Calculate the size of the bolts if the load is 25 kN and the yield stress is 380 N/mm^2. The factor of safety is taken as 2.5. Use maximum shear stress theory. **(10 Marks)**

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PART – B

5 A shaft supported between bearing 400mm apart gets its drive through a gear drive. A gear is mounted 200mm to the right of the left hand bearing and is driven by a pinion just above it. The gear has a module of 10mm, number if teeth is equal to 40 and pressure angle ϕ=20°, the power received is 20kW at 500 rpm. Overhanging to the right hand bearing by 200mm there is a pulley of diameter 200mm, the belt drive is inclined at an angle of 30° with the vertical and is away from the shaft. The ratio of belt tension is taken as 3:1. Design a shaft assuming that the allowable stress as 100 N/mm^2 in tension and 40 N/mm^2 in shear, for suddenly applied loads with minor shocks. **(20 Marks)**

6 a. A 45mm diameter, shaft is made of steel with a yield strength of 40 MPa. A parallel key of size 14mm wide and 9mm thick, made of steel with a yield strength of 340 MPa. Find the required length of key, if the shaft in loaded to transmit the maximum permissible torque. Design based on maximum shear stress theory and take factor of safety as 2. **(06 Marks)**

b. Design a bushed-pin type flexible coupling to connect a pump shaft to a motor shaft transmitting 32 kW at 960 rpm. The overall torque is 20 percent more than mean torque. The material properties are as follows:

i) The allowable shear and crushing stress for shaft and key material is 40 MPa and 80 MPa respectively.
ii) The allowable shear stress for cast iron is 15 MPa.
iii) The allowable bearing pressure for rubber bush is 0.8 N/mm^2.
iv) The material of the pin is same as that of shaft and key. **(14 Marks)**

7 a. A pulley has been fabricated by welding the rim of pulley to the annular web plate by a weld of size 3mm×3mm, where as hub is welded to the web plate by 5mm×5mm weld. Determine safe power that can be transmitted by this pulley and welded pulley considering only welded joint. [Refer Fig.7(a)]. **(10 Marks)**

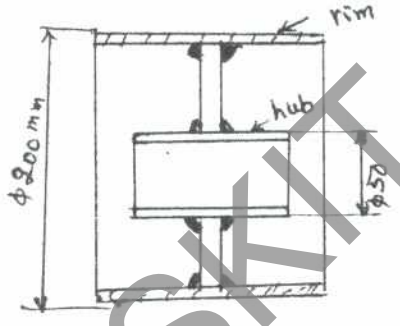

Fig.7(a)

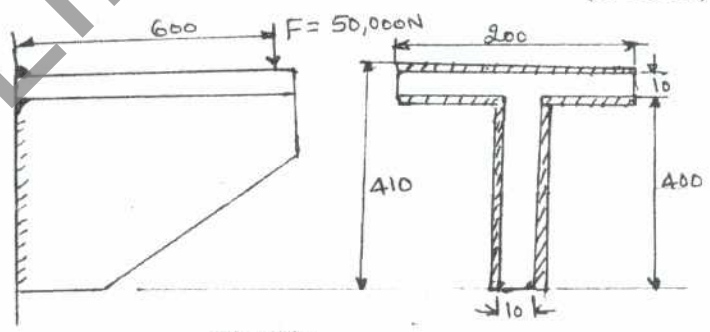

Fig.7(b)

b. An eccentric loaded connection is as shown in Fig.7(b). Determine the size of weld, if maximum shear stress induced in weld is not exceed 75 N/mm^2. **(10 Marks)**

8 a. A tie bar in a bridge consists of a plate 350mm wide and 20mm thick. It is connected by a plate of same thickness by a cover butt joint. Design an economical structural joint, if permissible stresses are, tensile stress 90 N/mm^2, shear stress 60 N/mm^2, Compressible stress 150 N/mm^2. **(10 Marks)**

b. A triple-threaded power screw is used in a screw jack, has a nominal diameter of 50 mm and a pitch of 8mm. The threads are square shape and the length of the nut is 48 mm. The screw jack is used to lift a load of 7.5 kN. The coefficient of friction at the threads is 0.12 and the collar friction is negligible. Calculate

i) The principle shear stresses in the screw rod.
ii) The transverse shear stress in the screw and nut.
iii) The bearing pressure for threads and
iv) State whether the screw is self locking. **(10 Marks)**

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06ME53

Fifth Semester B.E. Degree Examination, June-July 2009
Dynamics of Machines

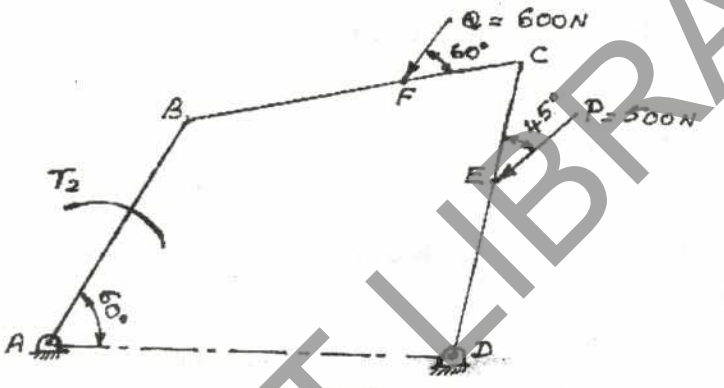
Time: 3 hrs. Max. Marks:100

Note:1. ***Answer any FIVE full questions, choosing at least two questions from each part.***
2. Use of drawing sheets is permitted.

Part A

1 a. State the conditions for a member to be in equilibrium,
i) when two forces act.
ii) when three forces act.
iii) when two forces and a torque act. **(06 Marks)**

b. A four bar mechanism under the action of two external forces is shown in figure Q1 (b). Determine the torque to be applied on the link AB for static equilibrium of the mechanism. **(14 Marks)**



AB = 50 mm; BC = 66 mm;
CD = 55 mm; CE = 25 mm;
CF = 30 mm; AD = 100 mm
$\hat{BAD}$ =60°

Fig. Q1 (b)

2 a. What are the requirements of an equivalent dynamical system? **(05 Marks)**

b. Obtain an expression for the Hoop stress developed in the rim of a flywheel. **(05 Marks)**

c. During one revolution of the crank of a multicylinder engine, the areas above and below the mean turning moment line taken in order are +0.36, -0.81, +0.75, -0.64, +0.92, -0.58 cm^2. Scale of the diagram, turning moment 1 cm^2 = 7200 Nm, Crank angle, 1 cm = 45°. The engine runs at 150 rpm and the total fluctuation of speed is 2% of the mean speed. Find i) Mass of flywheel ii) Area of cross section of rim. Neglect the effect of arms and boss and take the density of rim material as 7260 kg/m^3. Mean peripheral velocity of rim is 1000 m/min. **(10 Marks)**

3 a. Derive an expression for the ratio of tensions in flat belt drive. **(08 Marks)**

b. In a thrust bearing the external and internal radii of contact surfaces are 210 mm and 160 mm respectively. The total axial load is 60 kN and coefficient of friction is 0.05. The shaft is rotating at 380 rpm. Intensity of pressure is not to exceed 0.35 N/mm^2. Calculate
i) Number of collars required for the thrust bearing.
ii) Power lost due to friction. **(12 Marks)**

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4 a. Explain briefly static and dynamic balancing of rotating masses. **(04 Marks)**

b. A 3.6 m long shaft carries three pulleys, two at its two ends and the third pulley at the mid point. The two end pulleys have masses 79 kg and 40 kg respectively and their C_g are 3 mm and 5 mm from the axis of shaft respectively. The middle pulley has a mass of 50 kg and its C_g is 8 mm from the shaft axis. The pulleys are so keyed to the shaft that the assembly is in static balance. The shaft rotates at 300 rpm in two bearings, 2.4 m apart, with equal overhang on either side. Determine,

i) Relative angular position of the pulleys.

ii) Dynamic reaction on the two bearings. **(16 Marks)**

Part B

5 a. Prove that for a 90° V-engine the primary forces due to reciprocating parts can be balanced by rotating parts. **(06 Marks)**

b. The pistons of a four cylinder vertical inline engine reach their uppermost position at 90° interval in order of their axial position. The cylinder centre lines are spaced at 0.35 m. Length of crank = 0.12 m. Length of connecting rod = 0.42 m. The reciprocating mass per cylinder is 2.5 kg and the engine runs at 600 rpm. Determine the out of balance primary and secondary forces and couples on this engine taking the central plane of engine as reference plane. **(14 Marks)**

6 a. Define the following terms with reference to a governor. i) Sensitiveness ii) Governor effort iii) Power iv) Isochronism. **(08 Marks)**

b. The arms of a porter governor are 300 mm long. The upper arms are pivoted on the axis of rotation and the lower arms are attached to the sleeve at a distance of 35 mm from the axis of rotation. The mass of sleeve is 54 kg and the mass of each ball is 7 kg. Determine the equilibrium speed when the radius of rotation of the ball is 225 mm. What will be the range of speed for this position, if the frictional resistance to the motion of the sleeve is equivalent to a force of 30 N at the sleeve? **(12 Marks)**

7 a. Derive an expression for heel angle of a motor cycle to avoid skidding. **(10 Marks)**

b. The rotor of the turbine of a ship has a mass of 5000 kg and rotates at a speed of 2100 rpm clockwise when viewed from stern. The rotor has a radius of gyration of 0.5 m. Determine the gyroscopic couple and its effect when,

i) The ship steers to the left in a curve of 60 m radius at a speed of 16 knots (1 knot = 1860 m/hr).

ii) The ship pitches 6° above and 6° below the horizontal position and the bow is descending with its maximum velocity. The pitching motion is simple harmonic with a periodic time of 20 seconds. **(10 Marks)**

8 For a symmetrical tangent cam operating a roller follower, the least radius of cam is 30 mm and roller radius is 15 mm. The angle of ascent is 60°, the total lift is 15 mm and the speed of the cam shaft is 300 rpm. Calculate

i) Principal dimensions of cam.

ii) Acceleration of the follower at the beginning of the lift, when the roller just touches the nose (i.e. flank merges into the nose) and at the apex of the circular nose. Assume that there is no dwell between ascent and descent. **(20 Marks)**

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06ME54

Fifth Semester B.E. Degree Examination, June-July 2009
Energy Engineering

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, choosing at least two questions from each part.***

Part A

1 a. What are the factors to be considered for the establishment of thermal power plant? Explain briefly. **(06 Marks)**

b. Draw the general layout of thermal power plant and explain the various circuits. **(08 Marks)**

c. Why pulverization of coal is required? Explain any one furnace with sketch where pulverized coal is used as fuel. **(06 Marks)**

2 a. With neat sketch explain the working of Bemen boiler. **(06 Marks)**

b. What is draught? Explain any one type of draught with sketch. **(06 Marks)**

c. Derive the equation for the height of chimney. Calculate the height of chimney to produce draught of 20 mm of water when the temperature of flue gases is 290°C and ambient temperature = 20°C. The flue gases formed per kg of fuel burnt = 23 kg. **(08 Marks)**

3 a. Give the application of diesel power plant. **(08 Marks)**

b. Draw the general layout of diesel power plant and explain the working of different systems in brief. **(12 Marks)**

4 a. Define hydrograph and unit hydrograph and explain its importance in the design of storage of hydroelectric power project. **(08 Marks)**

b. Explain the working of hydroelectric power plant with sketch. **(12 Marks)**

Part B

5 a. Explain the phenomenon of nuclear fission and fusion. What are essential requirements to cause nuclear fission? **(05 Marks)**

b. Classify nuclear reactor. Explain BWR reactor with sketch giving its merits and demerits. **(10 Marks)**

c. Write a note on radioactive waste disposal. **(05 Marks)**

6 a. Define the terms: i) Solar constant ii) Direct radiation iii) Diffused radiation iv) Extra terrestrial radiation. **(04 Marks)**

b. Classify solar radiation measuring instruments. Explain any one instrument with sketch. **(05 Marks)**

c. With neat sketch explain the working of solar pond and photo voltaic cell. **(06 Marks)**

d. What are the major problems associated with wind power? Explain any one vertical axis windmill with sketch. **(05 Marks)**

7 a. Explain the terms: i) Tidal energy ii) Ebb tide iii) Flood tide iv) Ocean thermal energy. **(04 Marks)**

b. With neat sketch explain the working of OTEC plant. **(10 Marks)**

c. Explain with neat sketch how geothermal energy is extracted from the earth. **(06 Marks)**

8 a. Explain the working principle of biogas production from organic waste. **(10 Marks)**

b. What is gasifier? Explain any one gasifier with sketch. **(10 Marks)**

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06ME55

Fifth Semester B.E. Degree Examination, June-July 2009
Turbomachines

Time: 3 hrs. Max. Marks:100

Note : ***Answer any FIVE full questions, selecting atleast TWO questions from each Part***

PART – A

1 a. Define Turbomachine and Positive displacement machines. **(04 Marks)**

b. Differentiate between a turbomachine and a positive displacement machine under the following headlines : i) Action ii) Operation iii) Mechanical features iv) Efficiency of conversion v) Volumetric efficiency vi) Fluid phase change. **(06 Marks)**

c. Obtain an expression for i) Flow coefficient ii) Head coefficient and iii) Power coefficient of a turbomachine using Buckingham –π theorm. **(10 Marks)**

2 a. Derive alternate form of Euler's turbine equation and explain the significance of each energy component. **(10 Marks)**

b. The velocity of fluid flow from the nozzle in an axial flow impulse turbine is 1200m/s. The nozzle angle is 22^0. If the rotor blades are equiangular and the rotor tangential speed is 400m/s, find i) The rotor blade angles ii) The tangential force on the blade ring iii) Power output iv) Utilization factor. Assume $Vr_1 = Vr_2$. **(10 Marks)**

3 a. Define the following : i) Degree of reaction ii) Utilization factor. **(04 Marks)**

b. Draw the velocity triangles at inlet and outlet of an axial flow turbine when i) R is –ve ii) R = 0 iii) R = 0.5 iv) R = 1 v) R > 1. Discuss the energy transfer in each case. **(10 Marks)**

c. Air flows axially through an axial flow turbine at a mean radius of 0.2m. If the tangential component of absolute velocity is reduced by 20m/s during its passage through the rotor, find the power developed by the turbine for a flow rate of $100 m^3/s$ at a point, where the pressure and temperature are 1 bar and 27^0C. The rotational speed of rotor is 3000 rpm. **(06 Marks)**

4 a. What is Reheat factor? Show that the reheat factor is greator than unity in a multistage turbine. **(10 Marks)**

b. The output of a three stage gas turbine is 30MW at the shaft coupling at an entry temperature of 1500K. The overall pressure ratio across the turbine is 11.0 and efficiency 88%. If the pressure ratio of each stage is the same, determine : i) Pressure ratio of each stage ii) Polytropic efficiency iii) The mass flow rate iv) The efficiency and power of each stage. Assume $\gamma_{air} = 1.4$, $C_p = 1.005$ kJ/kg K, $\eta_{mech} = 91\%$. **(10 Marks)**

PART – B

5 a. What is the function of a diffuser? Name different types of diffusers used in centrifugal compressor and explain them with simple sketches. **(10 Marks)**

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b. A backward swept centrifugal fan develops a pressure of 75mmWG. If has an impeller diameter of 89cm and runs at 720 rpm. The blade angle at the tip is 39^0 and the width of the impeller is 10cm. Assuming a constant velocity of flow of 9.15m/s and density of $1.2kg/m^3$, determine the fan efficiency, discharge, power required, stage reaction and the pressure coefficient. **(10 Marks)**

6 a. Obtain an expression for the minimum starting speed of a centrifugal pump. **(10 Marks)**

b. The outer diameter of the impeller of a centrifugal pump is 40cm, and width of the impeller at outlet is 5cm. The pump is running at 800 rpm and is working against a total head of 15m. The vane angle at outlet is 40^0 and manometric efficiency is 75%. Determine

i) Velocity of flow at outlet ii) Velocity of water leaving the vane iii) Angle made by the absolute velocity at outlet with the direction of motion at outlet iv) Discharge. **(10 Marks)**

7 a. Show that the maximum efficiency for an impulse turbine is given by $Cos^2\alpha_1$, where α_1 is the angle at which steam enters the blades, with the help of combined velocity triangles. **(10 Marks)**

b. A single stage impulse turbine rotor has a diameter of 1.2m running at 3000 rpm. The nozzle angle is 18^0. Blade speed ratio is 0.42. The ratio of relative velocity at outlet to relative velocity at inlet is 0.9. The outlet angle of the blade is 3^0 smaller than the inlet angle. The steam flow rate is 5kg/s. Draw the velocity diagram and find the following :

i) Velocity of whirl ii) Axial thrust on the bearings iii) Blade angles iv) Power developed. **(10 Marks)**

8 a. Obtain an expression for the workdone / sec by water on the runnee of a peltonwheel. Hence derive an expression for maximum efficiency of peltonwheel giving the relationship between the jet speed and bucket speed. **(10 Marks)**

b. A three Jet pelton turbine is required to generate 10,000 kW under a net head of 400m. The blade angle at outlet is 15^0 and the reduction in the relative velocity while passing over the blades is 5%. If the overall efficiency of the wheel is 80%, $C_v = 0.98$ and the speed ratio is 0.46 then find:

i) Total flow in m^3/s ii) Discharge through each Jet iii) Diameter of the Jet iv) Force exerted by Jet on the wheel. **(10 Marks)**

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06ME56

Fifth Semester B.E. Degree Examination, June-July 2009
Engineering Economics

Time: 3 hrs. Max. Marks:100

Note: *1. Answer any FIVE full questions, choosing at least two from each part.*
2. Use of "Compounding Interest factors" tables are permitted.

PART – A

1 a. Define "Problem Solving" and "Decision making" with examples. **(05 Marks)**

b. A company 3 years ago borrowed Rs.40,000/- to pay for a new machine tool, agreeing to repay the loan in 100 monthly payments at an annual nominal interest rate of 12% compounded monthly. The company now wants to pay off the loan. How much would this payment be, assuming no penalty costs for early payout? **(15 Marks)**

2 a. State and explain any five conditions for present worth comparisons. **(10 Marks)**

b. An investor can make three end of year payments of Rs.15,000/- which are expected to generate receipts of Rs.10,000/- at the end of year 4 that will increase annually by Rs.2500/- for the following 4 years. If the investor can earn a rate of return of 10% on other 8 year investments, is this alternative attractive? **(10 Marks)**

3 a. Define and explain the terms
i) Service life; ii) Accounting life; iii) Economic life. **(09 Marks)**

b. Two models of small machines perform the same functions. Type 1 machine has a low initial cost of Rs.9500/-, relatively high operating costs of Rs.1900/- per year more than that of type 2 machine, and a short life of 4 years. The more expensive type 2 machine costs Rs.25,100/- and can be kept in service economically for 8 years. The scrap value from either machine of its life will barely cover its removal cost. Which is preferred when minimum rate or return is 8%? **(11 Marks)**

4 a. Define Depreciation and explain any one method of calculating depreciation. **(05 Marks)**

b. Explain in brief the three types of rates of return. **(06 Marks)**

c. Computers purchased by a public utility cost Rs.7000/- each. Past records indicate that they have useful life of 5 years, after which, they will be disposed of, with no salvage value. The company currently has a cost capital of 7%. Determine the following by using straight line method.
i) Depreciation charge during year 1 and 2.
ii) Depreciation reserve accumulated at the end of year 3.
iii) The Book value of computers at the end of year 3. **(09 Marks)**

PART – B

5 a. Explain in brief Direct Material cost, Direct labour cost, Marginal cost. **(06 Marks)**

b. Explain in brief Administrative over Heads and Selling over heads. **(04 Marks)**

c. A small firm is producing 100 pens/day. The direct material cost is found to be Rs.160, direct labour cost is Rs.200 and factory overheads chargeable are Rs.250. If the selling on cost is 40% of factory cost, what must be the selling price of each pen to realize a profit of 14.6% of selling price? **(10 Marks)**

6 a. Explain in brief the systems of Book-keeping. **(10 Marks)**

b. Explain the importance of Balance sheet and prepare a balance sheet showing different accounts (Balance sheet model). **(10 Marks)**

7 a. Define and explain liquidity Ratio and leverage Ratio. **(10 Marks)**

b. Calculate the current assets of a firm with the following data:
Stock turnover Ratio = 5 times; Stock at the end = 5000 more than stock in beginning
Sales = 2,00,000; Gross Profit Ratio = 20%
Current liabilities = Rs.60,000/-; Quick Ratio = 0.75. **(10 Marks)**

8 a. Enumerate and explain objectives of Profit planning. **(10 Marks)**

b. Define Budget and give a brief classification of budget. **(10 Marks)**

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