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10ME52

Fifth Semester B.E. Degree Examination, Jan./Feb.2021
Design of Machine Elements – I

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Use of design data hand book is permitted.***
3. ***Assume missing data, if any.***

PART – A

1 a. What are the factors to be considered for the selection of a material for a machine component? **(04 Marks)**

b. What is mechanical engineering design? Explain. **(04 Marks)**

c. A bracket with a rectangular cross section is shown in Fig. Q1 (c). The depth of cross section is twice the width. The force P acting on the bracket at 60° to vertical is 5 kN. The material of the bracket is grey cast-iron FG200 and the factor of safety is 3.5. Determine the dimensions of the cross section of the bracket.

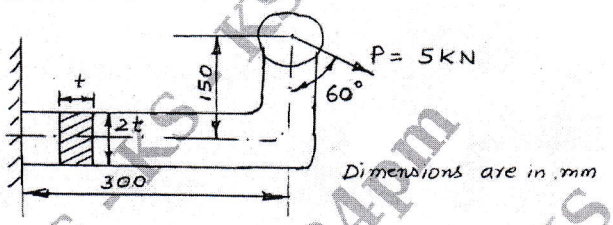

Fig. Q1 (c) **(12 Marks)**

2 a. State and explain the following theories of failure: (i) Maximum normal stress theory (ii) Maximum shear stress theory. **(06 Marks)**

b. Define stress concentration factor. Explain the methods used to reduce the stress concentration in a machine component. **(06 Marks)**

c. A flat plate subjected to a tensile force of 5 kN is shown in Fig. Q2 (c). The plate material is Grey Cast Iron FG200 (σ_{ut} = 200 MPa) and factor of safety is 2.5. Determine the thickness of the plate.

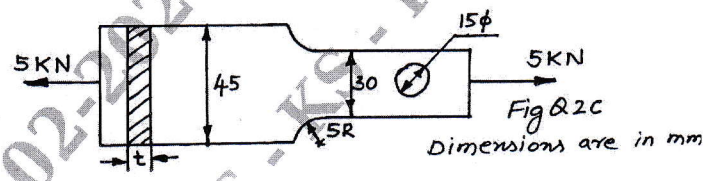

Fig. Q2 (c) **(08 Marks)**

3 a. Sketch SN-diagram and indicate Low cycle fatigue, High cycle fatigue on it. **(04 Marks)**

b. Define Endurance Limit. Name and explain any four factors which affect Endurance limit. **(06 Marks)**

c. A stepped shaft with reduction ratio of 1.2 is to have a fillet radius of 10% of smaller diameter. The shaft is to be made of a material that has a notch sensitivity factor of 0.925, shear stress of 160 MPa at yield and shear stress of 120 MPa at endurance limit. Take surface correction factor of 0.90, size correction factor of 0.85 and factor of safety as 2.5. Determine the diameter of the stepped shaft to sustain a twisting moment that fluctuates between +800 Nm to −500 Nm. **(10 Marks)**

4 a. Briefly explain the various types of stresses in threaded fasteners. **(08 Marks)**

b. A structural connection shown in Fig. Q4 (b) is subjected to an eccentric force of 10 kN with an eccentricity of 500 mm. The centre distance between bolts 1 and 2 is 200 mm and the centre distance between bolts 1 and 3 is 150 mm. All the bolts are identical. The bolts are made of a material having yield strength in tension of 400 MPa. Take factor of safety as 2.5. Determine the size of the bolts. **(12 Marks)**

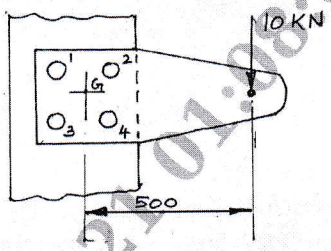

Fig. Q4 (b)

PART – B

5 A power transmission shaft 1500 mm long is supported by two bearings at A and D. A spur gear 20° involute and 175 mm diameter is keyed to the shaft at C 400 mm to the left of the right hand bearing and is driven by another spur gear directly behind it. A 600 mm diameter pulley is keyed to the shaft at B to the right of left hand bearing and drives a pulley with a horizontal belt directly behind it. The ratio of belt tensions is 3 : 1, with slack side on top. The drive transmits 45 kW at 330 rpm. The combined shock and fatigue factors for torsion and bending are 1.5. Draw the bending moment diagrams and determine the necessary shaft diameter. **(20 Marks)**

6 a. Name and explain any four types of keys. **(04 Marks)**

b. Prove that a square key is equally strong in shear and compression. **(04 Marks)**

c. Design a socket and spigot type cotter joint to carry an axial force of 100 kN. Use the following stresses : Allowable stress in tension and bending = 100 MPa ; Allowable stress in crushing = 150 MPa ; Allowable stress in shear = 60 MPa Sketch two views of joint showing major dimensions. **(12 Marks)**

7 a. Design a double riveted lap joint using 9 mm thick plates. The safe working stresses in tension, crushing and shear are 80 MPa, 120 MPa and 60 MPa respectively. Draw two views of the Joint. **(10 Marks)**

b. Determine the size of weld required for an eccentrically loaded weld as shown n Fig. Q7 (b). The allowable stress in the weld is 95 MPa.

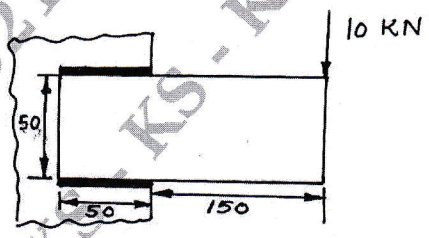

Fig. Q7 (b) **(10 Marks)**

8 a. Explain self locking and over hauling in power screws. **(05 Marks)**

b. A weight of 500 kN is raised at a speed of 6 m/min by two screw rods with square threads of 50×8 cut on them. The two screw rods are driven through bevel gear drives by a motor. Determine (i) Torque required to raise the load (ii) The speed of rotation of the screw rod assuming the threads are of double start (iii) Maximum stress induced on the cross section of the screw rod (iv) Efficiency of screw drive. **(15 Marks)**

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10ME53

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Energy Engineering

Time: 3 hrs. Max. Marks:100

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

PART - A

1 a. Explain with a neat sketch, the working of Spreader Stroker. Discuss the advantages and disadvantages. **(08 Marks)**

b. Explain with a neat sketch, hydraulic ash handling system. **(06 Marks)**

c. Explain with a neat sketch, the working of cyclone burner. **(06 Marks)**

2 a. Explain with a neat sketch, working of Rolex boiler. **(08 Marks)**

b. Define draught and explain the balanced draught system, with neat sketch. **(08 Marks)**

c. What is Super heater and Economiser? **(04 Marks)**

3 a. List the essential components of diesel power plant and explain them briefly. **(07 Marks)**

b. Explain with the help of a neat sketch, the working of a thermostatically controlled cooling system. **(07 Marks)**

c. Explain briefly the following lubrication systems :
i) Wet sump lubrication system ii) Dry sump lubrication system. **(06 Marks)**

4 a. Explain with a neat sketch the essential elements of hydro – electric power plant. **(10 Marks)**

b. At a particular site of a river the mean monthly discharge for 12 months is tabulated below :

Month	Discharge (Millions of m^3 per month)	Month	Discharge (Millions of m^3 per month)
April	250	Oct	1000
May	100	Nov	750
June	750	Dec	750
July	1250	Jan	500
Aug	1500	Feb	400
Sept	1200	Mar	300

i) Draw hydrograph for the given discharges and find the average monthly flow.
ii) Draw the flwo duration curve.
iii) The power available at mean flow of water if available head is 90 meters at the site and overall efficiency of generation is 82 percent. Take 30 days in a month. **(10 Marks)**

PART - B

5 a. Explain with a neat sketch the working of Fast breader reactor. State its advantages and disadvantages. **(10 Marks)**

b. Explain briefly about the functions of a moderator. **(04 Marks)**

c. Write short notes on radiation hazards and disposal of radioactive wastes. **(06 Marks)**

6 a. What are the applications of the solar pond? Explain with the help of a neat sketches solar pond electric power plant. **(08 Marks)**

b. What is the principle of photovoltaic power generation? Explain with a neat sketch, the working of photovoltaic cell. **(06 Marks)**

c. Explain with a neat sketch, horizontal axis wind mill. **(06 Marks)**

7 a. Explain the principle of OTEC. Explain with a neat sketch, Rankine cycle OTEC plant. **(08 Marks)**

b. With neat sketch, explain the working of Tidal Power Plant. **(06 Marks)**

c. Explain with a neat sketch, the working of "Hot Dry Rock" geothermal plant. **(06 Marks)**

8 a. Explain with the help of a neat sketch the working principle of KVIC biogas plant. **(10 Marks)**

b. Write short notes on Photosynthesis and Anaerobic fermentation. **(06 Marks)**

c. Differentiate Biomass and Biogas. **(04 Marks)**

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10ME54

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Dynamics of Machines

Time: 3 hrs. Max. Marks:100

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

PART - A

1 a. Explain principle of virtual work with necessary diagram. **(06 Marks)**

b. A four bar mechanism under the action of two external forces is shown in Fig. Q1(b). Determine the torque to be applied on the link AB for static equilibrium. The dimensions of the links are AB = 50mm , BC = 66mm , CD = 55mm , CE = 25mm , CF = 30mm , AD = 100mm , Angle BAD = 60^0 , P = 500N and Q = 600N. **(14 Marks)**

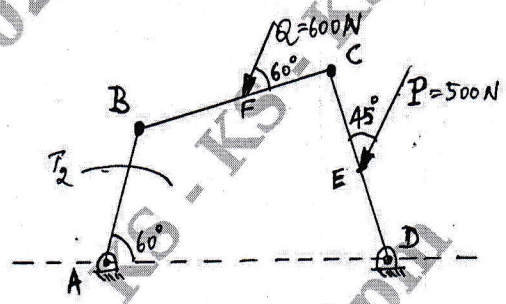

Fig.Q1(b)

2 a. Briefly discuss the following :
i) D' Alembert's principle ii) Dynamically equivalent system. **(06 Marks)**

b. A certain machine requires a torque of (5000 + 500 sin θ) N-m to drive it, where θ is the angle of rotation of shaft measured from certain datum. The machine is directly coupled to an engine which produces a torque of (5000 + 600 sin2θ) N-m. The fly wheel and the other rotating parts attached to the engine has a mass of 500kg at a radius of gyration of 0.4m. If the mean speed is 150 r.p.m, find i) The fluctuation of energy ii) The percentage fluctuation of speed iii) The maximum and minimum angular acceleration of the fly wheel and the corresponding shaft position. **(14 Marks)**

3 a. Derive an expression for frictional torque in a flat pivot bearing assuming uniform pressure and uniform wear. **(08 Marks)**

b. An open belt drive connects two pulleys 1200mm and 500mm diameters, on parallel shafts 4m apart. The maximum tension in the belt is 2000N. The coefficient of friction is 0.3. The driver pulley of diameter 1200mm runs at 200 rpm. Calculate
i) the power transmitted ii) torque on each of the two shafts. **(12 Marks)**

4 a. Define Static and Dynamic balancing. **(04 Marks)**

b. Four masses M_1 = 100 kg ; M_2 = 175kg ; M_3 = 200 kg and M_4 = 125kg are fixed to the crank of 200mm radius and revolve in planes 1, 2, 3 and 4 respectively. The angular position of the planes 2, 3, and 4 with respect to 1 are 75^0 , 135^0 and 240^0 taken in the same sense. Distances of the planes 2, 3, and 4 from 1 are 600mm, 1800mm and 2400mm. Determine the magnitude and position of the balancing masses at radius 600mm in planes L and M located in the middle of 1 and 2 and in the middle of 3 and 4 respectively. **(16 Marks)**

PART - B

5 In an in – line six cylinder engine working on two stroke cycle, the cylinder center lines are spaced at 600mm. In the end view, the cranks are 60^0 apart and in the order 1-4-5-2-3-6. The stroke of each piston is 400mm and the connecting rod length is 1m. The mass of the reciprocating parts is 200kg per cylinder and that of rotating parts 100kg per crank. The engine rotates at 300 r.p.m. Examine the engine for the balance of primary and secondary forces and couples. Find the maximum unbalanced forces and couples. **(20 Marks)**

6 a. Derive an expression for the spring stiffness in case of Hartnell governor neglecting obliquity effect of arms. **(08 Marks)**

b. The arms of a porter governor are each 250mm long and pivoted on the governor axis. Mass of each ball is 5kg and the mass of central sleeve is 30kg. The radius of rotation of the balls is 15cm when the sleeve begins to rise and reaches a value of 20cm for maximum speed. Determine the speed range of the governor. If the friction of the sleeve is equivalent to 20N, determine how the speed range is modified. **(12 Marks)**

7 a. Analyse the stability of a two – wheel vehicle taking a turn and derive the necessary equations. **(08 Marks)**

b. An Aeroplane makes a complete half – circle of 40m radius towards left when flying at 175km/hr. The mass of the rotary engine and propeller is 400kg with radius of gyration 300mm. The engine runs at 2500 rpm clockwise when viewed from the rear. Find the gyroscopic couple on the aircraft. What will be the effect if the aeroplane twin towards right instead of left? **(12 Marks)**

8 A symmetrical tangent cam with a least radius of 25mm operates a roller follower of radius 10mm. The angle of ascent is 60^0 and total lift is 15mm. If the speed of the cam is 400 rpm, then calculate i) The main dimensions of the cam ii) the acceleration of the follower at

a. The beginning of the lift.
b. When the roller just touches the nose.
c. The apex of the circular nose.

Assume there is no dwell between ascent and distance. **(20 Marks)**

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10ME55

Fifth Semester B.E. Degree Examination, Jan./Feb.2021
Manufacturing Process – III

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. With neat sketches, explain the classification of metal working processes on the basis of force applied. **(10 Marks)**

b. An aluminum alloy having σ_0 (uni-axial flow stress) as 500 MPa is subjected to three principal stresses σ_x as 200 MPa (tensile), $\sigma_y = 100$ MPa (tensile), $\sigma_z = 500$ MPa (compressive) and shear stress = 50 MPa will the material exhibit yielding? If not, what is the safety factor? **(04 Marks)**

c. Explain the different methods to determine the flow stress. **(06 Marks)**

2 a. Explain the effect of the following on metal working processes:
(i) Strain rate
(ii) Temperature. **(10 Marks)**

b. Explain with a neat sketch the hydrostatic pressure in metal working. **(05 Marks)**

c. Discuss the concept of deformation zone geometry in metal working. **(05 Marks)**

3 a. With the help of sketch explain the following forging operations:
(i) Upsetting
(ii) Drawing
(iii) Fullering. **(06 Marks)**

b. Derive an expression for slab analysis to determine the mean pressure for closed die forging. **(08 Marks)**

c. An aluminium billet 24mmϕ, 40 mm high is compressed between flat parallel dies to a height of 18 mm. The average yield stress is 6 N/mm^2. Find the frictionless workdone. Also determine the maximum pressure exerted if the coefficient of friction is 0.24. **(06 Marks)**

4 a. Describe the effect of front and back tension on the rolling loads. **(06 Marks)**

b. Explain the following rolling mills :
(i) Cluster mill (ii) Tandem mill. **(06 Marks)**

c. Calculate the rolling load if steel is hot rolled 30% from a 40 mm thick slab using a 900 mm diameter roll. The slab is 760 mm wide. Assume $\mu = 0.3$, the plan strain flow stress is 140 MPa at entrance and 200 MPa at the exit from the roll gap due to the increasing velocity. **(08 Marks)**

PART – B

5 a. Explain with sketch the wire drawing and rod drawing operations. **(06 Marks)**

b. Explain optimal cone angle and dead zone formation in drawing. **(06 Marks)**

c. Determine the drawing stress to produce a 20% reduction in a 10 mm stainless steel wire. The flow stress is given by $\sigma_0 = 1300 \epsilon^{0.30}$ MPa. The die angle is 12° and $\mu = 0.09$. If the wire is moving through the die at 3 m/sec, determine the power required to produce the deformation. **(08 Marks)**

6 a. Explain with a neat sketch the Direct Extrusion and Indirect Extrusion Processes. **(06 Marks)**
b. Write a note on extrusion equipment, die design and lubrication. **(06 Marks)**
c. An aluminium alloy is hot extruded at 400°C at 50 mm/sec from 150 mm diameter to 50 mm diameter. The flow stress at this temperature is given by $\bar{\sigma} = 200\left(\dot{\epsilon}\right)^{0.15}$ MPa. If the billet is 380 mm long and the extrusion is done through square dies without lubrication. Determine the force required for the operation. Assume $\mu = 0.1$. **(08 Marks)**

7 a. Give the classification of dies in sheet metal and explain combination dies with neat sketch. **(08 Marks)**
b. Explain the following operations with neat sketches :
   (i) Stretch forming.
   (ii) Rubber forming. **(06 Marks)**
c. List the defects in sheet metal formed parts. **(06 Marks)**

8 a. Discuss the principle of "High Energy Rate Forming" methods and with a neat sketch explain the explosive forming. **(08 Marks)**
b. Explain different steps involved in powder metallurgy process with the help of flow diagram. **(08 Marks)**
c. List the applications of powder metallurgy components. **(04 Marks)**

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10ME56

Fifth Semester B.E. Degree Examination, Jan./Feb. 2021
Turbomachines

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO full questions from each part.***

PART – A

1 a. How are turbo machines classified? Compare turbo machines with positive displacement machines. **(08 Marks)**

b. Define unit speed, and obtain an expression for unit speed. **(04 Marks)**

c. The diameter of a centrifugal pump, which is discharging $0.03m^3/s$ of water against a total head of 20m is 0.40m. The pump is running at 1500rpm. Find the head, discharge and ratio of powers of a geometrically similar pump of diameter 0.25m when it is running at 3000rpm. **(08 Marks)**

2 a. What is Reheat factor in a multistage turbine? Prove that reheat factor is greater than unity. **(08 Marks)**

b. Define: i) Stage efficiency ii) Polytropic efficiency. **(04 Marks)**

c. An air compressor has eight stages of equal pressure ratio 1.3. The flow rate through the compressor and its overall efficiency are 45kg/s and 80% respectively. If the conditions of air at entry are 1 bar and 35°C, determine: i) State of air at compressor exit ii) Polytropic efficiency iii) Stage efficiency. **(08 Marks)**

3 a. Write the general equation for utilization factor and prove that for maximum utilization factor the speed ratio $\rho = \frac{\cos\alpha_1}{2}$ in impulse turbine, and $\rho = \cos\alpha_1$ for 50% reaction turbine. Draw the velocity triangles for both the cases. **(10 Marks)**

b. In a mixed flow turbomachine the fluid enters such that the absolute velocity is axial at inlet and at outlet relative velocity is radial. What is the degree of reaction and energy input to the fluid, if relative velocity at outlet is same as tangential blade speed of inlet? The following data may be used:

i) Inlet diameter = 16cm
ii) Exit diameter = 50cm
iii) Speed = 3000rpm
iv) Blade angle = 45° at inlet. **(10 Marks)**

4 a. Show that with the help of velocity triangles, for maximum utilization and same amount of energy transfer in impulse and 50% reaction turbine

$U_R = \sqrt{2U_I^2}$

Where U_R = Blade speed of 50% reaction turbine
U_I = Blade speed of Impulse turbine. **(10 Marks)**

b. A single stage axial flow blower with no inlet guide vanes but a row of stationary vanes down stream of rotor operates at 3600 rpm. The tip and hub diameter of the rotor are 200mm and 125mm respectively. The air flow rate through the stage is 0.45kg/s. The air is sucked through an angle of 20° towards axial direction during passage through the rotor at the arithmetic mean diameter. Assuming standard atmospheric conditions (1 bar, 25°C) and no losses in the rotor compute power input and degree of reaction. **(10 Marks)**

PART – B

5 a. Show the expansion of steam through an impulse turbine in a number of stages on h-s diagram, and explain i) Stage efficiency ii) Reheat factor iii) Internal turbine efficiency. **(08 Marks)**

b. The following data refer to a single stage impulse turbine. Isentropic nozzle heat drop = 251kJ/kg nozzle efficiency = 90%; nozzle angle = 20°; ratio of blade speed to whirl component of steam speed = 0.5, blade velocity coefficient = 0.9; the velocity of steam entering the nozzle = 20m/s.

Determine:

i) The blade angles at inlet and outlet if the steam enters into the blades without shock and leaves the blades in an axial direction.

ii) Blade efficiency.

iii) Power developed if the steam flow is 8kg/s. **(12 Marks)**

6 a. Classify hydraulic turbines with examples. **(06 Marks)**

b. Explain the function of draft tube. Mention the different types of draft tube. **(04 Marks)**

c. An axial flow turbine of runner diameter 4.5m is running at 40rpm. The guide blade angle at inlet is 145° and runner blade angle at outlet is 25° to the direction of vanes. The axial flow area of water through runner is $25m^2$. If the runner blade angle at inlet is radial determine: i) Hydraulic efficiency of the turbine; ii) Discharge through turbine; iii) Power developed. **(10 Marks)**

7 a. Explain the working of a single stage centrifugal pump with neat sketch. **(06 Marks)**

b. What are the effects of cavitation? Give the necessary precautions against cavitation. **(04 Marks)**

c. A centrifugal pump with 1.2m diameter runs at 200rpm, and pumps 1880 *l*ts/s, the average lift being 6m. The angle which the vanes make at exit with the tangent to the impeller is 26° and the radial velocity of flow is 2.5m/s. Determine the monometric efficiency and the least speed to start pumping against head of 6m, the inner diameter of the impeller being 0.6m. **(10 Marks)**

8 a. Explain briefly the phenomenon of surge and chocking in centrifugal compressor. **(08 Marks)**

b. What is meant by slip? **(02 Marks)**

c. A centrifugal compressor compresses 30kg of air per second at a rotational speed of 15000rpm. The air enters the compressor axially, and the conditions at the exit sections are, radius = 0.3m, relative velocity of air at the tip is 100m/s at an exit angle of 80°. Find the torque and power required to drive the compressor and also the ideal head developed. Take P_{01} = 1 bar and T_{01} = 300k. **(10 Marks)**

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