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17ME51

Fifth Semester B.E. Degree Examination, July/August 2021
Management and Engineering Economics

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer any FIVE full questions.***
2. ***Use of Interest chart is permitted.***

1 a. Define Management. List and explain different interpersonal roles played by a Senior Manager. **(08 Marks)**
b. Briefly explain Management and Administration. **(04 Marks)**
c. List and explain important contributions made by F.W. Taylor under Scientific Management. **(08 Marks)**

2 a. Compare Strategic planning and Tactical planning. **(04 Marks)**
b. Explain briefly the guidelines for making planning effective. **(06 Marks)**
c. Identify the situations for Individual and Group decisions. Briefly explain the advantages and disadvantages of Group decision. **(10 Marks)**

3 a. What is Span of Control? Briefly explain the factors governing the span of control. **(06 Marks)**
b. What do you mean by a Committee? How are they broadly classified? Briefly explain. **(04 Marks)**
c. Briefly explain the Selection Procedure. **(10 Marks)**

4 a. Briefly explain the essentials of Effective Control System. **(08 Marks)**
b. Explain the important characteristics of leadership. **(04 Marks)**
c. Define Communication. List some of the important purposes of communication. **(08 Marks)**

5 a. With a neat block diagram, explain the process of problem solving and decision making in Engineering Economics. **(10 Marks)**
b. Explain Law of Demand and Supply with suitable example. **(06 Marks)**
c. Define the Law of Return and explain the three phases of Law of return. **(04 Marks)**

6 a. Define Compound Interest. Briefly explain the three types of Compound Interest. **(06 Marks)**
b. With a neat diagram, explain Cash Flow diagram. **(06 Marks)**
c. A person wants to give Rs 25,000 as scholarship every year in memory of his late father. He wants to deposit a lump sum in the bank which makes him to receive the required amount every year for the next 20 years. The reserve is assumed to grow annually at the rate of 9%. Find the single payment that must be made now as the reserve amount. **(08 Marks)**

7 a. How are assets with unequal lives compared? **(05 Marks)**
b. Explain the "Rule of 72" as applied to Present worth comparisons. **(05 Marks)**
c. Compare the Present worth of the following alternatives using an interest rate of 7% :

	Plan A	Plan B	Plan C
Life Cycle (years)	6	3	4
First cost (Rs)	2,000	8,000	10,000
Annual cost (Rs)	3,200	700	500

(10 Marks)

8 a. Explain i) Ownership life ii) Accounting life iii) Economic life. **(06 Marks)**
b. Explain : i) MARR ii) IRR. **(04 Marks)**
c. A patch of land adjacent to International Airport is likely to increase in value. The cost of the land now is Rs 8,00,000 and expected worth is Rs 15,00,000 within 5 years. During the period it can be rented for a small Industry at Rs 15,000 per year. Annual taxes are Rs 8,500 and likely to remain constant. What rate of return will be earned on the investment if the estimates are accurate? **(10 Marks)**

9 a. Differentiate between Estimation and Costing. **(04 Marks)**
b. Explain the following terms :
i) Prime cost ii) Factory cost iii) Cost of Production iv) Total cost. **(06 Marks)**
c. Two operators are engaged on forging machine for 25 jobs, each weighing 4 kg in a shift of 8 hrs. They are paid at the rate of Rs 100/hr and Rs 80/hr per day. The forged material costs Rs 3.50 per kg. If the factory and administrative on costs put together are twice the labour cost , find the cost of production per unit. **(10 Marks)**

10 a. What is Depreciation? List different methods of determining depreciation. Explain any two of them. **(10 Marks)**
b. A Company has purchased an equipment whose first cost is Rs 2,00,000 with an estimated life of eight years. The estimated salvage value of the equipment is Rs 40,000 at the end of its lifetime. Determine the depreciation change and book value at the end of various years using sum of years digits method of depreciation. **(10 Marks)**

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17ME52

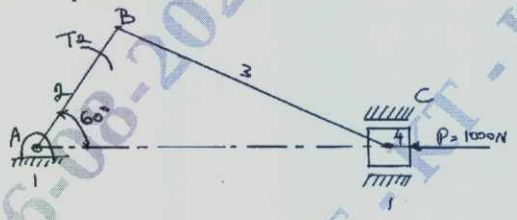
Fifth Semester B.E. Degree Examination, July/August 2021
Dynamics of Machinery

Time: 3 hrs. Max. Marks: 100

Note: *Answer any FIVE full questions.*

1 a. State the condition for static equilibrium of a body subjected to a system of (i) Two forces, (ii) Three forces (iii) Member with two forces and a torque. **(06 Marks)**

b. Determine the required input torque on the crank of a slider crank mechanism shown in Fig. Q1 (b) for static equilibrium. **(14 Marks)**



AB = 100 mm,
BC = 300 mm

Fig. Q1 (b)

2 a. State and explain D'Alembert's principle. **(06 Marks)**

b. A horizontal gas engine running at 240 rpm has a bore of 500 mm and a stroke of 600 mm. The length of connecting rod is 1.2 m and the mass of the reciprocating parts is 200 kg. The difference between driving and back pressure is 0.4 N/mm^2 when the crank has turned through an angle of 60° from the inner dead centre. Neglecting the effect of piston rod, Determine

(i) Net force on the piston or piston effort.
(ii) Thrust in the connecting rod.
(iii) Pressure in the slide bars.
(iv) Tangential force on the crank pin.
(v) Thrust on the bearings.
(vi) Turning moment on the crank shaft.
(vii) Acceleration of the flywheel which has a mass of 100 kg and radius of gyration of 500 mm while the power of the engine is 100 kW. **(14 Marks)**

3 a. Briefly explain the static and dynamic balancing. **(06 Marks)**

b. Two masses m_1, m_2, m_3, m_4 and m_5 revolve in the same plane. Magnitudes of m_1, m_2 and m_3 are 5, 2.5 and 4 kg respectively. Angular positions of m_2, m_3, m_4 and m_5 are 60°, 135°, 210° and 270° from m_1. Determine the masses m_4 and m_5. **(14 Marks)**

4 In a four cylinder engine the two outer cranks are at 120° to each other and their reciprocating masses are each 100 kg. The distance between the planes of rotation of adjacent cranks are 450 mm, 750 mm and 450 mm. Length of each crank is 300 mm and length of each connecting rod is 1200 mm. Speed of engine is 240 rpm. Find

(i) The reciprocating masses and relative angular positions for each of the inner cranks.
(ii) The unbalanced secondary forces and couples if any, measured about the central plane for this arrangement arrived at for primary balancing. **(20 Marks)**

5 a. Define the following with respect to the working of Governors:

(i) Sensitiveness
(ii) Isochronism
(iii) Hunting of governor
(iv) Effort of a governor
(v) Stability of a governor **(10 Marks)**

b. Each ball of a Governor has a mass of 1.5 kg attached to one arm of a bell crank lever. The other arms of bell crank lever. The other arms of bell crank lever lift the sleeve against the force exerted by the spring under compression which surrounds the governor spindle. Length of ball and sleeve arms are 125 and 75 mm. Fulcrum is 90 mm from the axis. Maximum and minimum radii are 115 and 75 mm. The sleeve begins to lift at a speed of 300 rpm. Maximum speed is 6% greater. Find the rate of spring or stiffness and equilibrium speed for the radius 90 mm. **(10 Marks)**

6 a. Analyze the stability of a two wheel vehicle taking left turn. Derive the necessary equations. **(10 Marks)**

b. An aeroplane makes a complete half circle of 50 m radius towards left when flying at 200 km/hr. The mass of the rotary engine and propeller is 400 kg with radius of gyration 300 mm. The engine runs at 3000 rpm counter clockwise when viewed from the rear. Determine the gyroscopic couple and its effect on the air craft. **(10 Marks)**

7 a. Define the following with respect to vibration:
(i) Simple Harmonic Motion (SHM).
(ii) Degrees of freedom.
(iii) Phase difference.
(iv) Resonance.
(v) Damping. **(10 Marks)**

b. Add the following harmonic motions and check the solution graphically,

$x_1 = 2\cos(\omega t + 0.5)$

$x_2 = 5\sin(\omega t + 1.0)$ **(10 Marks)**

8 a. Determine the natural frequency of a spring mass system where the mass of the spring is also to be taken into account. **(06 Marks)**

b. An oscillating system with a natural frequency of 3.98 Hz starts with an initial displacement of $x_0 = 10$ mm and an initial velocity of $\dot{x}_0 = 125$ mm/sec. Calculate all the vibratory parameters involved and the time taken to reach the first peak. **(14 Marks)**

9 a. State the types of damping and explain the differential equation of viscous damping. **(08 Marks)**

b. Large guns are designed so that on firing the bavel records against a spring. At the end of the record a dash pot is engaged that allows the bavel to return to its initial position in the minimum time without oscillation. Determine the proper spring constant and the dashpot damping co-efficient for a bavel having a mass of 900 kg. Initial recorded velocity at the instant of firing is 25 m/sec and the distance recorded is 1.5 m. Also find the time required for the bavel to return to a position 0.15 m from the initial position if the time for recorded is $\frac{1}{4}$ of time period. **(12 Marks)**

10 a. Show that providing damping in vibration isolation is not useful when the frequency ratio is more than 1.414 or $\sqrt{2}$. **(08 Marks)**

b. A machine of total mass 68 kg mounted on springs of stiffness $k = 11{,}000$ N/cm. With an assumed damping factor $\xi = 0.2$. A piston within the machine has a mass of 2 kg has a reciprocating motion with stroke 7.5 cm and a speed of 3,000 rpm. Assuming the motion of piston to be S.H.M. Determine
(i) Amplitude of machine
(ii) Phase angle with respect to exciting force.
(iii) Transmissibility and force transmitted to foundation.
(iv) Phase angle of transmitted force with respect to exciting force. **(12 Marks)**

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17ME53

Fifth Semester B.E. Degree Examination, July/August 2021
Turbo Machines

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions.

1 a. Summarize the difference between a positive displacement machines and turbomachines. **(08 Marks)**

b. Test on a turbomachine runner of diameter 1.25m runs at 30m head and gave the following results. Power developed – 736kW, speed of 180rpm with a discharge of 2.7m^3/s. Find the diameter, speed and discharge of a runner to operate at 45m head and gives 1472kW at the same efficiency. What is specific speed of both the turbines? **(08 Marks)**

c. Discuss briefly the effect of Reynold's number on a fluid flow in turbomachines. **(04 Marks)**

2 a. Show that the polytropic efficiency during the process of expansion is given by

$$\eta_p = \frac{\ell_n\left(\frac{T_2}{T_1}\right)}{\frac{\gamma-1}{\gamma}\ell_n\left(\frac{P_2}{P_1}\right)}$$ **(10 Marks)**

b. A stream of combustion gases at the point of entry to a turbine has a static temperature of 1050K, static pressure of 600kPa and a velocity of 150m/s. For the gases, C_p-1.004kJ/kg K and γ-1.41. Find the total temperature and total pressure of the gases. Also find the difference between their static and total enthalpies. **(10 Marks)**

3 a. Considering the elements of energy transfer. Derive an alternate form of Euler Turbine equation. **(10 Marks)**

b. In an axial flow turbine, the discharge blade angles are 20° each, for both the stator and the rotor. The steam speed at the exit of the fixed blade is 140m/s. The ratio of $\frac{V_a}{u} = 0.7$ at the entry and 0.76 at the exit of the rotor blade. Find: i) The inlet rotor blade angle ii) Power developed by the blade ring for a mass flow rate of 2.6kg/sec iii) Degree of reaction. **(10 Marks)**

4 a. Derive theoretical Head-Capacity (H-Q) relation in case of radial flow pump (centrifugal)

$$H = u_2^2 - \frac{u_2^2 Q \cot\beta_2}{A_2}$$

β_2 = discharge blade angle with respect to tangential direction. Explain the effect of discharge angle on it. **(10 Marks)**

b. An axial flow compressor has the following data entry conditions: 1 bar and 20°C, degree of reaction = 50%, mean blade ring diameter = 60cm, rotational speed = 18000rpm, blade angle at rotor and stator exit = 65°. Axial velocity = 180m/s, mechanical efficiency = 96.7%. Find:

i) Blade angle at rotor and stator inlet

ii) Power required to drive the compressors. **(10 Marks)**

5 a. With a neat sketch, explain the pressure-velocity compounding of steam turbine. **(10 Marks)**

b. In a Curtis stage with two rows of moving blades the rotor are equiangular. The first rotor has angle of 29° each while second rotor has angle of 32° each. The velocity of steam at the exit nozzle is 530m/s and the blade co-coefficients are 0.9 in the first, 0.95 in the stator and in the second rotor. If the absolute velocity at the stage exit should be axial, Find:
i) Mean blade speed ii) Rotor efficiency iii) Power output for a flow rate of 32kg/sec. **(10 Marks)**

6 a. Derive the condition for maximum efficiency of reaction steam turbine and hence prove that

$$\eta_{b\max} = \frac{2\text{Cos}^2\alpha_1}{1+\text{Cos}^2\alpha_1}$$ **(10 Marks)**

b. A Parson's turbine is running at 1200rpm. The mean rotor diameter is 1m. Blade outlet angle is 23°, speed ratio is 0.75 stage efficiency is 0.8. Find Enthalpy drop in this stage. **(10 Marks)**

7 a. Show that for a Pelton turbine the maximum hydraulic efficiency is given by

$\eta_{max} = \frac{1+C_b\text{Cos}\beta_2}{2}$ where C_b = blade velocity coefficient, β_2 = Blade discharge angle. **(10 Marks)**

b. In a power station, a pelton wheel producer 15000kW under a head of 350m while running at 500rpm. Assume turbine efficiency of 0.84, coefficient of velocity for nozzle as 0.98, speed ratio 0.46 and bucket velocity coefficient 0.86. Calculate:
i) Number of jet ii) Diameter of each jet iii) Tangential force on the buckets if the bucket deflect the jet through 165°. **(10 Marks)**

8 a. Define the following: i) Monometric Head ii) Hydraulic Efficiency iii) Mechanical Efficiency iv) Overall efficiency v) Volumetric efficiency. **(10 Marks)**

b. In a Francis turbine, the discharge is radial, the blade speed at inlet is 25m/s. At the inlet tangential component of velocity is 18m/s. The radial velocity of flow is constant and equal to 2.5m/s. Water flows at the rate of $0.8m^3$/sec. The utilization factor is 0.82. Find:
i) Euler's head ii) Power developed iii) Degree of reaction (R) iv) Inlet blade angle
Draw the velocity triangles. **(10 Marks)**

9 a. What are the applications of multistage centrifugal pumps? With a neat sketch, explain centrifugal pumps in series and parallel. **(10 Marks)**

b. A centrifugal pump working in a dock, pumps 1565*l*/sec, against head (mean lift) of 6.1m, when the impeller rotates at 200rpm. The impeller diameter is 122cm and the area at outlet periphery is $6450cm^2$. If the vanes are set back at an angle of 26° at the outlet. Find: i) Hydraulic efficiency ii) Power required to drive the pump. If the ratio of external to internal diameter is 2, find the minimum speed to start pumping. **(10 Marks)**

10 a. For axial flow compressor, show that

$$E = V_f u\left[\frac{\tan\beta_2 - \tan\beta_1}{\tan\beta_1\tan\beta_2}\right]$$ **(10 Marks)**

b. What are the types of diffuser used in centrifugal compressor? Explain any two. **(10 Marks)**

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17ME54

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

Time: 3 hrs. Max. Marks: 100

Note: 1. Answer any FIVE full questions.
2. Any missing data may be suitably assumed.
3. Use of design data handbook is permitted.

1 a. What is Mechanical Engineering Design? Explain the steps involved in design with a block diagram. **(08 Marks)**

b. A circular rod of diameter 50mm is subjected to loads as shown in Fig.Q1(b). Determine the nature and magnitude of stresses at the critical points. **(12 Marks)**

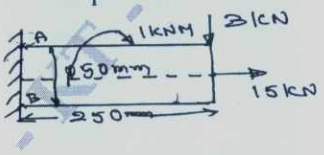

Fig.Q1(b)

2 a. What is stress concentration? Explain the factors affecting the stress concentration. **(04 Marks)**

b. State and explain the theories of failure applicable to (i) ductile (ii) brittle material. **(04 Marks)**

c. Determine the maximum stress induced in the semi circular grooved shaft shown in Fig.Q2(c), if it is subjected to (i) An axial load of 40 kN (ii) A bending moment of 400 N-m (iii) A Twisting moment of 500 N-m. Take the stress concentration into account.

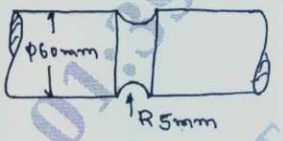

Fig.Q2(c) **(12 Marks)**

3 a. Derive an expression for stress induced in a rod due to the axial impact of a weight 'W' dropped from a height 'h' on to a collar attached at the free end of the rod. What is the stress due to suddenly applied load? **(08 Marks)**

b. A cantilever beam of span 800 mm has a rectangular cross-section of depth 200mm. The free end of the beam is subjected to a transverse load of 1 kN that drops on to it from a height of 40mm. Selecting C-40 steel (σ_y = 328.6 MPa) and factor of safety = 3, determine the width of rectangular cross section. **(12 Marks)**

4 a. Derive Soderberg's relation for a member subjected to fatigue loading. **(05 Marks)**

b. Determine the maximum load for the simply supported beam, cyclically loaded as shown in Fig.Q4(b). The ultimate strength is 700 MPa. The yield point in tension is 520 MPa and the endurance limit is reversed bending is 320 MPa. Use a factor of safety of 1.25. The load, size and surface correction factors are 1, 0.75 and 0.9 respectively. **(15 Marks)**

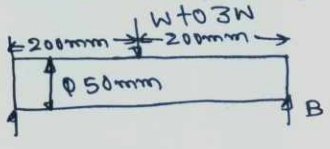

Fig.Q4(b)

5 A horizontal piece of commercial shafting is supported by two bearings 1.5m apart. A keyed gear 20° involute and 175 mm in diameter is located 400mm to the left of the right bearing and is driven by a gear directly behind it. A 600 mm diameter pulley is keyed to the shaft 600 mm to the right of the left bearing and drives a pulley with a horizontal belt directly behind it. The tension ratio of the belt is 3 to 1, with the slack side on top. The drive transmits 45 kW at 330 rpm. Take $k_b = k_t = 1.5$. Calculate the necessary diameter of the shaft and angular deflection in degrees. Use allowable shear stress 40 MPa and $G = 80\times10^9$ N/mm^2. **(20 Marks)**

6 a. Design a Knuckle joint to transmit 150 kN. The design stress may be taken as 75 N/mm^2 in tension, 60 N/mm^2 in shear and 150 N/mm^2 in compression. **(10 Marks)**

b. Design a protected type cast iron flange coupling for a steel shaft transmitting 30 kW at 200 rpm. The allowable shear stress in the shaft and key material is 40 MPa. The maximum torque transmitted to be 20% greater than the full load torque. The allowable shear stress in the bolt is 60 MPa and the allowable shear stress in the flange is 40 MPa. **(10 Marks)**

7 a. Design a triple riveted lap joint zig-zag type, for a pressure vessel of 1.5 M diameter. The maximum pressure inside the vessel is 1.5 MPa. The allowable stresses in tension, crushing and shear are 100, 125 and 75 MPa respectively. **(10 Marks)**

b. Determine the diameter of rivet for the joint shown in Fig.Q7(b). The allowable stress in the rivets is 100 N/mm^2.

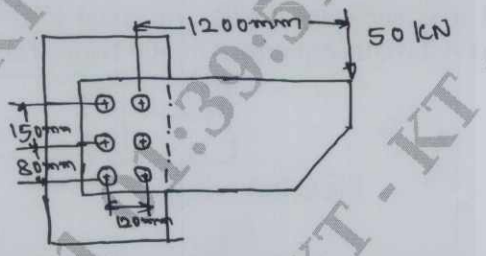

Fig.Q7(b) **(10 Marks)**

8 a. A plate of 80 mm wide and 15 mm thick is joined with another plate by a single transverse weld and a double parallel weld. Determine the length of parallel fillet weld if the joint is subjected to both static and fatigue loading. Take $\sigma_t = 90$ MPa, $\tau = 55$ MPa as the allowable stresses and stress concentration factors as 1.5 for transverse and 2.7 for parallel weld. **(10 Marks)**

b. A 16 mm thick plate is welded to a vertical support by two fillet welds shown in Fig.Q8(b). Determine the size of weld, if the permissible shear stress for the weld material is 75 MPa.

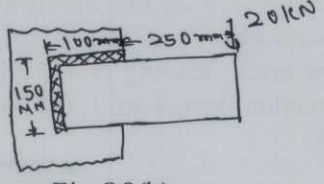

Fig.Q8(b) **(10 Marks)**

9 a. A bracket is fixed to the wall by means of four bolts and loaded as shown in Fig.Q9(a). Calculate the size of the bolt if the load is 10 kN and allowable shear stress in the bolt material is 40 MPa.

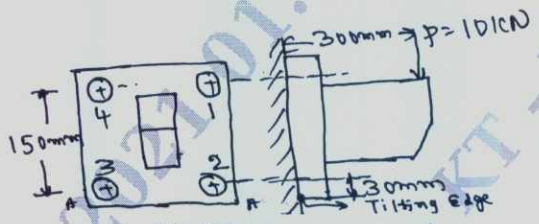

Fig.Q9(a) **(10 Marks)**

b. The structural connection shown in Fig.Q9(b) is subjected to an eccentric load P of 10 kN with an eccentricity of 500mm. The centre distance between bolts at 1 and 3 is 150mm and the centre distance between bolts 1 and 2 is 200mm. All the bolts are identical. The bolts are made of plain carbon steel having yield strength in tension of 400 MPa and the F.O.S is 2.5. Determine size of bolts. **(10 Marks)**

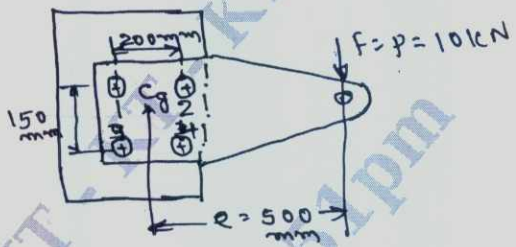

Fig.Q9(b)

10 a. Explain self locking and overhauling in power screws. **(05 Marks)**

b. A square threaded power screw has a nominal diameter of 30mm and a pitch of 6mm with double threads. The load on the screw is 6 kN and the mean diameter of the thrust collar is 40mm. The C.O.F for the screw is 0.1 and the collar is 0.09. Determine

(i) Torque required to raise the screw against load.
(ii) Torque required to lower the screw with the load.
(iii) Overall efficiency
(iv) Is this screw self-locking. **(15 Marks)**

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