[This question paper contains 04 printed pages]

Roll Number: _____

HPAS (Main) Examination-2018

MECHANICAL ENGINEERING-I

Time: 3 Hours   Maximum Marks: 100

Note:

1. This question paper contains eight questions. Attempt total five questions including question No.8 which is compulsory.

2. Each question carries equal marks. Marks are divided and indicated against each part of the question.

3. Write legibly. Each part of the question must be answered in sequence in the same continuation.

4. If questions are attempted in excess of the prescribed number only questions attempted first up to the prescribed number shall be valued and the remaining answers will be ignored.

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1. (a) A simply supported of 2m length carries uniformly distributed load of 2kN/m and a pointed load of 1kN at the center. Find the reactions at the ends. Also draw the shear force and bending moment diagram of the beam. What is theory of pure bending?

(10)

   (b) Young's modulus of mild steel is 5×10^5MPa. Find out the maximum tensile load which can be applied on a steel wire of 5mm diameter without undergoing permanent deformation if it's yield stress is 40MPa. Also find out the maximum elastic strain energy which can be stored in the wire. Also find out the true stress and true strain at the yield point of the wire.   (10)

2. (a) In a four-link mechanism shown in Fig.Q1, external torque T_4 (*on link* 4) has magnitude of 20 N-m (CCW). Determine the magnitude and direction of torque (T_2) that must be applied to

link 2 to maintain static equilibrium of the mechanism. Also compute the pin reactions at point A and D. (10)

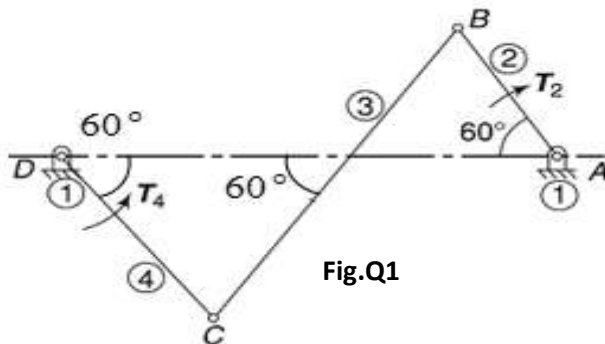Given: AB = 300 mm, AD = BC =700 mm and CD = 400 mm.

Fig.Q1

2. (b) A wheel and tire assembly is run at 100 rpm on a dynamic balancing machine as shown in Fig.Q2. The force measured at the left bearing had a peak of 22.24 N at a phase angle of 45° with respect to zero reference angle on the tire. The force measured at the right bearing had a peak of 8.9 N at a phase angle (-) 120° with respect to the reference zero on the tire. The centre distance between the two bearings on the machine is 254 mm. The left edge of the wheel rim is 101.6 mm from the centerline of the closest bearing. The wheel is 177.8 mm wide at the rim. Calculate the size and location with respect to the tire zero reference angle, of balance weights needed on each side of the rim to dynamically balance the tire assembly. The wheel rim diameter is 381 mm. (10)
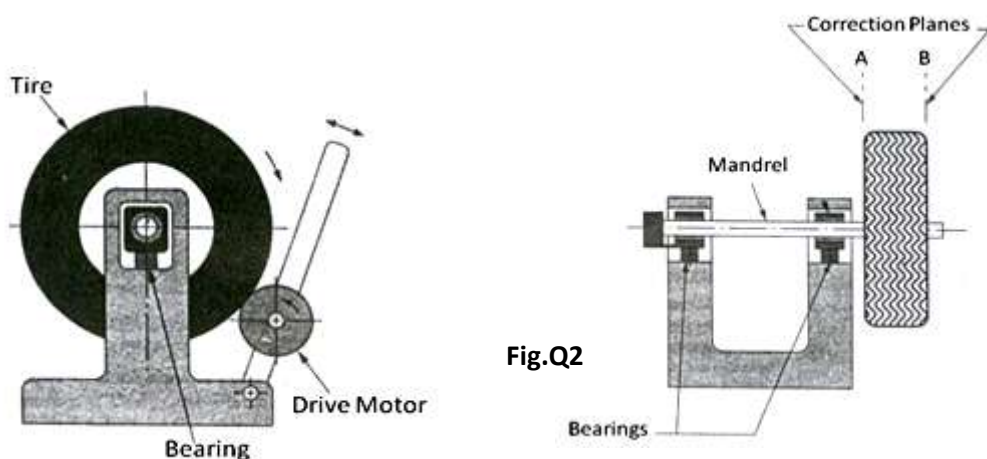

Fig.Q2

3. (a) Explain the term "strain hardening" from grain structure of a material?

A metal has a flow curve with strength coefficient = 850 MPa and strain-hardening exponent = 0.30. A tensile specimen of the metal with gage length = 100 mm is stretched to a length = 157 mm. Determine the flow stress at the new length and the average flow stress that the metal has been subjected to during the deformation. (10)

(b) What is yield of a casting? How is it related to "Shrinkage" of casting during solidification?

Calculate the dimensions of the sprue to avoid air aspiration effect to feed liquid metal at a rate of 10 kg/s. density of liquid metal is 7800 kg/m^3. Assume the height of sprue as 20 cm and height of pouring basin is 6 cm. (10)

4. (a) What is the difference between conventional machining and nontraditional machining process? Explain with an example. (10)

(b) Draw the typical TTT diagram of an eutectoid steel and show the following heat treatment processes in it a) Annealing b) Normalising c) Quenching d) Tempering e) Austempering and f) Martempering. How does these processes influence the properties of the steel after the heat treatment. Explain with suitable microstructure. (10)

5. (a) Mary George, operations manager at Kansas Furniture, has received the following estimates of demand requirements:-

July	Aug.	Sept.	Oct.	Nov.	Dec.
1000	1200	1400	1800	1800	1800

Assuming stockout costs for lost sales of $100 per unit, inventory carrying costs of $25 per unit per month, and zero beginning and ending inventory, evaluate following two plans and report the best plan.

Plan A: Produce at a steady rate (equal to minimum requirements) of 1,000 units per month and subcontract additional units at a $60 per unit premium cost.

Plan B: Vary the workforce, which performs at a current production (July month) level of 1,300 units per month. The cost

of hiring additional workers is $3,000 per 100 units produced. The cost of layoffs is $6,000 per 100 units cut back. (10)

(b) Give examples for the application of control charts for attributes, number of defects and number of defectives with reference to manufacturing industries. Which of the charts will you prefer for the quality control production process for a) Automobile shaft manufacturing company b) Foundry manufacturing engine blocks and c) An electric company manufacturing CFLs. (10)

6. (a) In machine tool beds it is normally written as "Flame hardened". What do you understand from this term? Why is it done? How is it related to the accuracy of machining process? (10)

(b) Power transmission shafts are normally "Shot peened" or "Sand blasted". Why is this done? How does it affect the fatigue life of the shaft? Explain with suitable diagram. (10)

7. (a) Explain the following welding defects and give the possible reasons for such defects a) Centerline crack b) Spatter c) Slag inclusion d) Undercut and e) distortion. Explain the method to avoid the recurrence of such defects. (10)

(b) It is required to butt weld 200mm thick plates for manufacturing boiler drum. List the different type of welding process applicable for this. Also give their relative advantages and disadvantages.

(10)

8. Explain the following:- (05x04=20)

    i) Mechanism used in Shapers to reduce the return time.
    ii) Ductile and Brittle fracture.
    iii) Effect of temperature on stress strain diagram.
    iv) Work in process inventory and line balancing.