

This question paper contains 7 printed pages]

Code No. : 16(I)

Roll No.

0(CCEM)9

MECHANICAL ENGINEERING

Paper : I

Time Allowed : 3 hours]

[Maximum Marks : 300

- Note :*
- (i) Answers must be written in English.*
 - (ii) The number of marks carried by each question is indicated at the end of the question.*
 - (iii) Part/Parts of the same question must be answered together and must not be interposed between answers to other questions.*
 - (iv) The answer to each question or part thereof should begin on a fresh page.*
 - (v) Your answers should be precise and coherent.*
 - (vi) Candidates should attempt Question Nos. 1 and 5 which are compulsory and any three out of the remaining questions, selecting at least one question from each Section.*

SECTION – A

1. Answer any *three* of the following : 20 × 3
- (a) Define the following :
 - (i) Tensile stress,

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16(I)

- (ii) Compressive stress,
 - (iii) Shear stress,
 - (iv) Hoop stress,
 - (v) Poisson's ratio.
- (b) Derive relations for the torque transmitted by a single plate clutch when :
- (i) intensity of pressure is uniform, and
 - (ii) intensity of wear is uniform.
- (c) (i) Define a jig and fixture.
- (ii) What are the functions of jig and fixture ?
- (iii) What are main differences between a Jig and Fixture ?
- (d) (i) List the types of control charts.
- (ii) Write down objectives of control charts.
- (iii) Name four uses of control charts.
- (iv) Differentiate between variable and attributes.
2. (a) A beam of uniform section is 10m long and is simply supported at the ends. It carries concentrated loads of 100 kN and 60 kN at distances of 2m and 5m from the left end. Find the deflection under each load. Find also maximum deflection.

Take $E = 200 \text{ kN/mm}^2$ and $I = 18 \times 10^8 \text{ mm}^4$ 30

(2)

- (b) The Taylorian tool life equation for machining C-40 steel with a HSS cutting tool at a feed of 0.2 mm/min and a depth of cut of 2mm is given by $VT^n = C$ where n and C are constants. The following V and T observations have been noted.

$V, \text{m/min}$	25	35
T, min	90	20

Calculate

- (i) n and C .
 - (ii) Hence recommend the cutting speed for a desired tool life of 60 minutes. 20
- (c) Define the term 'Machinability'. Explain how it is influenced by mechanical properties of work materials? 10

3. (a) Four masses 150 kg, 250 kg, 200 kg and 300 kg are rotating in the same plane at radii of 0.25 m, 0.2 m, 0.3 m and 0.35 m respectively. Their angular location is 40° , 120° and 250° from mass of 150 kg measured in anticlockwise direction. Find the position and magnitude of balance mass required, if its radius of rotation is 0.25 m. 30

- (b) (i) Explain the principle and product application of ECM.
- (ii) List the requirements of tool materials for ECM (Electro Chemical Machining).
- (iii) Compare the similarities between ECM and EDM (Electrical Discharge Machining). 30

16(I)

4. (a) A flat belt is required to transmit 35 kw from a pulley of 1.5 m effective diameter running at 300 rpm. The angle of contact is 165° . The coefficient of friction between belt and pulley surface is 0.8. Find, taking centrifugal tension into account, width of belt required. The belt thickness is 9.5 mm, density of material is 1.1 mg/m^3 and the related permissible working stress is 2.5 N/mm^2 . 30
- (b) A company having plants at A, B and C supplies to the warehouses at D, E, F and G. Monthly plant capacities are 70, 90 and 115. Monthly warehouse requirements are 50, 60, 70 and 95 respectively. Unit shipping costs are as follows :

Plants \ Warehouse	D	E	F	G
A	17	20	14	12
B	15	21	25	14
C	15	14	15	16

Show that the total cost for initial solution is Rs. 5160.

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SECTION - B

5. Answer any *three* of the following : 20 × 3
- (a) Define (i) Free, (ii) Forced and, (iii) Damped vibrations with neat sketches and give examples.
- Derive an expression for the whirling speed of a shaft for synchronous whirl.

(4)

- (b) State and explain the first theorem of Castigliano. Using this theorem, show that the deflection at the centre of a beam of span l carrying a uniformly distributed load of w per unit run over whole span is $\frac{5}{384} \frac{wl^4}{EI}$. Assume uniform flexural rigidity.
- (c) (i) Compare confined and non confined systems of explosive forming.
(ii) Discuss the basic principle of high velocity forming methods.
- (d) Discuss briefly on :
(i) Line balancing,
(ii) ABC analysis and,
(iii) Economic Order Quality.
6. (a) The turbine rotor of a ship has a mass of 8 tonnes and a radius of gyration 0.6 m. It rotates at 1800 rpm clockwise, when looking from the stern. Determine the gyroscopic couple and its effect on the ship. The ship travels at 27.8 m/s and steers to the left in a curve of 75 m radius. 30
- (b) What are the various elements of surface roughness ? Explain with a sketch. Discuss a method for evaluation of surface roughness. 30

16(I)

7. (a) In an epicyclic gear train, the arm carries a planet wheel A having 36 teeth. The wheel A meshes with sun wheel B having 45 teeth and gears with fixed annular wheel C. Determine the following :

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- (i) Number of teeth on the annular gear,
- (ii) The speed and direction of Sun gear, if the arm rotates at 100 rpm.

(b) (i) Explain 'Work Sampling'.

- (ii) The following are the results of a work sampling study which took place over a 300 hour period during which the worker was observed while processing 27000 parts.

No. of observations

Working 1600

Non-working400

The worker when working was rated at 80% normal performance. For this type of work, the usual allowances should be 10% of total work day (8 hours). Find the standard number of units produced per hour. 30

8. (a) Find the thickness of metal necessary for a steel cylindrical shell of internal diameter 200 mm to withstand an internal pressure of 50 N/mm². The maximum hoop stress in the section is not to exceed 150 N/mm². 20

(6)

- (b) A simple band brake is operated by a lever of length 600 mm long. The brake drum has a diameter of 500 mm and the brake band embraces $\frac{5}{8}$ of circumference. One end of the band is attached to the fulcrum of the lever while the other is attached to a pin on the lever 100 mm from the fulcrum. If the effort applied to the end of lever is 2 kN and coefficient of friction is 0.25, find the maximum braking torque on the drum. 20
- (c) Explain the following briefly :
- (i) Quality control and its uses in product design,
 - (ii) Regression analysis. 20
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