1(CCE-M)6

MECHANICAL ENGINEERING-I

[16]

Time Allowed -3 Hours   *Maximum Marks-300*

INSTRUCTIONS

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)   *The answer to each question or part thereof should begin on a fresh page.*

iv)   *Your answer should be precise and coherent.*

v)   *The part/parts of the same question must be answered together and should not be interposed between answers to other questions.*

vi)   *Candidates should attempt **Five** questions, Question No.**1 and 5** which are compulsory and any **Three** more out of the remaining questions, selecting at least **One** question, from each section.*

vii)   *If you encounter any typographical error, please read it as it appears in text book.*

viii)   *Candidates are in their own interest advised to go through the General instructions on the back side of the title page of the Answer Script for strict adherence.*

ix)   *No Continuation sheets shall be provided to any candidate under any circumstances.*

x)   *Candidates shall put a cross (X) on blank pages of Answer Script.*

xi)   *No blank page be left in between answer to various questions.*

xii)   *No programmable Calculator is allowed.*

xiii)   *No stencil (with different markings) is allowed.*

xiv)   *In no circumstances help of scribe will be allowed.*

SECTION-A

1.   Answer any **three** of the following:
      a)   Define the following:
           i)   Machinability
           ii)   Law of belting
           iii) Gyroscopic couple
           iv)   Inversion of a slider crank chain
           v)   Reverted gear train   (25)

b) Differentiate the following:
   i)   Jigs and fixtures
   ii)   Cutting and forming
   iii) Value engineering and value-analysis
   iv)   Conventional and unconventional machining processes
   v)   Brakes and Dynamometer   (25)

c) Write short-notes on the following:
   i)   Stress in Rotating Disks and Cylinders
   ii)   Principle of virtual work
   iii) Displacement diagram
   iv)   Crowning of pulleys in flat-belt drives   (25)
   v)   Standard system of gears

d) Briefly describe the following:
   i)   State and derive the law of gearing
   ii)   Discuss the mechanism of creep in belt drive
   iii) Under-damped and over-damped Vibrations
   iv)   Function of flywheel
   v)   State and prove Castigliano's second theorem.   (25)

2. a) i)   A close-coiled helical spring has coil diameter (D), wire diameter (d) and number of turns (n). The spring material has a shearing modulus (G). Derive an expression for the stiffness K of the spring.   (05)

   ii) In a torsion test, the specimen is hollow shaft with 50mm external and 30mm internal diameter. An applied torque of 1.6kN-m is found to produce an angular twist of 0.4° measured on a length of 0.2m of the shaft. The Young's modulus of elasticity obtained from tensile test has been found to be 200GPa.   (20)
        Find the value of
        1) Modulus of rigidity
        2) Poisson's ratio

   b) Explain the process of electrical discharge machining, its process parameters and applications.   (25)

3. a) A shaft which rotates at a constant speed of 160 r.p.m. is connected by belting to a parallel shaft 720 mm apart, which has to run at 60, 80 and 100 r.p.m. The smallest pulley on the driving shaft is 40mm in radius. Determine the remaining radii of the two stepped pulleys for condition
   i)   A crossed belt and
   ii)   An open belt. Neglect belt thickness and slip.   (25)

b) i) Discuss in detail the principle and influence of process variables upon the material removal in ultrasonic machining. (10)

ii) Derive the equation for volumetric material removal rate involved in grain throwing model of ultrasonic machining. (15)

4. a) i) Explain the sensitiveness, hunting, stability and isochronous of governors. (05)

ii) A Proell governor has equal arm's length 300mm. The upper and lower ends of the arms are pivoted on the axis of the governor. The extension arms of the lower links are each 80mm long and parallel to the axis when the radii of rotation of the balls are 150mm and 200mm. The mass of each ball 10kg and the mass of the central load is 100kg. Determine the range of the governor. (20)

b) ASMIT Corporation has given the following information on its capacity, sales and cost as follows:

1) current capacity = 1,00,000 units
2) at current level of operations, its margin of safety is 5 percent of its break-even point.
3) contribution margin P/V ratio = 25 percent
4) The unutilised capacity at present is 10,000 units
5) Sales price Rs. 40 per unit.

Find:

i) Break-even point in sales volumes
ii) Fixed costs.
iii) Variable costs per unit
iv) Margin of safety in units
v) If the fixed costs are decreased by Rs. 1,80,000 to what extent can the price be reduced to maintain the total profit at current level. (25)

SECTION-B

5. a) Explain any **three** of the following: (3×25=75)

i) Primary and Secondary balancing of a reciprocating machine
ii) Force analysis of wire and tube drawing
iii) Mechanics of Rolling
iv) Design of Limit Gauges
v) Drive the conditions of high velocity forming
vi) Causes and effect of vibration on machine tool

6. a) i) Derive the expression for minimum number of teeth on a pinion for involute rack to avoid interference. (10)

ii) In an epicyclic gear train, an arm carries two gears A and B having 36 and 45 teeth respectively. If the arm rotates at 150 r.p.m. in the anticlockwise direction about the centre of the gear A which is fixed, determine the speed of gear B. If the gear A instead of being fixed, makes 300 r.p.m. in the clockwise direction, what will be the speed of gear B? (15)

b) i) Explain the principal techniques of work measurement and their applications. **(05)**

ii) Explain briefly the step of work sampling study. **(05)**

iii) Explain the nature of transportation problem. Give its mathematical stimulation as an LP problem. **(05)**

iv) Describe the method of constructing X and R chart and explain how these charts help in determining lack of control. **(05)**

v) Write short note on Six sigma. **(05)**

7. a) i) What is Economics Order Quantity? Derive the formula for EOQ when shortage is allowed. **(07)**

ii) Discuss with a neat sketch the 'Merchant force diagram and its importance in machining. **(08)**

iii) A cam with convex flanks operating a flat faced follower has base circle diameter of 7.5cm and nose radius of 1cm. The lift of the follower is 1.9cm. The cam is symmetrical about a line drawn through the centre of nose and centre of cam shaft. The total angle of action is 120°. Determine maximum velocity, acceleration and retardation of the follower when the camshaft rotates at 600 r.p.m. **(15)**

b) Explain the following terms with respect to linear programming: **(20)**

i) Slacks and surplus variables

ii) Decision variables

iii) Degeneracy in linear programming

iv) Basic solutions, feasible solution, basic feasible solution and optimal solution.

8. a) A beam of rectangular cross-section 50mm wide and 100mm deep is simply supported over a span of 1500mm. It carries a concentrated load of 50kN, 500mm from the left support. Calculate: **(25)**

i) Draw SFD and BMD

ii) The maximum tensile stress in the beam and indicate where it occurs;

iii) The vertical deflection of the beam at a point 500mm from the right support.

Take E for the material of beam = 2×10^5 MPa

b) With the help of a simple schematic diagram, explain the working of Electro chemical machining process. Prove the self-adjusting feature of ECM? Explain the surface finish is adversely affect by: selective dissolution and sporadic breakdown of anodic film. **(25)**

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