PAPER ID-311668

Subject Code: RME101

Roll No: | | | | | | | | | | | | | |

B TECH
(SEM-II) THEORY EXAMINATION 2020-21
ELEMENTS OF MECHANICAL ENGINEERING

Time: 3 Hours ***Total Marks: 70***

Note: 1. Attempt all Sections.

SECTION A

1. Attempt *all* questions in brief. **2 x 7 = 14**

a) Write down the statement of Varignon's theorem.
b) Define the term point of contraflexure.
c) Define radius of gyration.
d) Define the term modulus of Elasticity, bulk modulus, and modulus of rigidity.
e) Define Poisson's ratio.
f) Explain the concept of continuum.
g) Differentiate between coefficient of performance and efficiency. Also write down the relation between COP of a heat pump and refrigerator.

SECTION B

2. Attempt any *three* of the following: **7 x 3 = 2**

a) Forces 2, 3, 5, 3 and 2 kN respectively act at one of the angular points of a regular hexagon towards five other angular points. Determine the magnitude and direction of the resultant force.
b) Draw the shear force and bending moment diagram for the beam as shown in Figure below. Also find the magnitude and position of maximum bending.

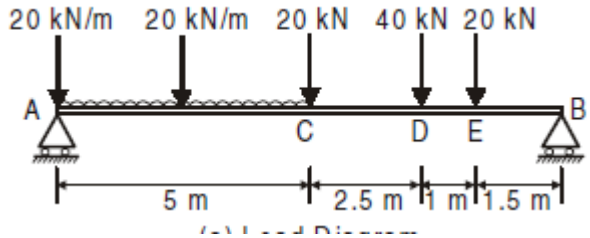


Figure.

c) The strength of a 400 mm deep and 200 mm wide *I*-beam of uniform thickness 10 mm, is increased by welding a 250 mm wide and 20 mm thick plate to its upper flanges as shown in Fig. Determine the moment of inertia and the radii of gyration of the composite section with respect to cetroidal axes parallel to and perpendicular to the bottom edge *AB*.

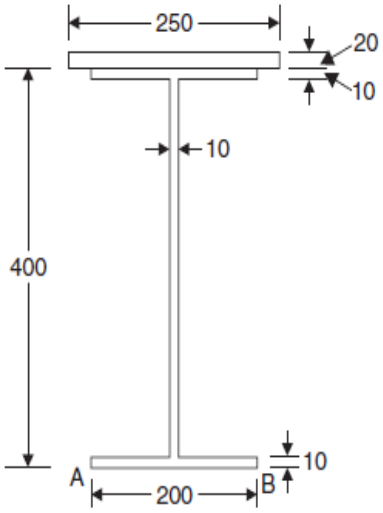


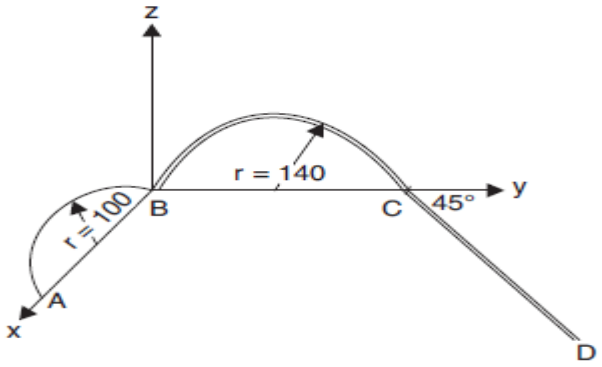
Figure.

d) A bar of 25 mm diameter is tested in tension. It is observed that when a load of 60kN is applied, the extension measured over a guage length of 200 mm is 0.12 mm and contraction in diameter is 0.0045 mm. Find Poisson's ratio and elastic constants E, G, and *K*.
e) Explain the working of four stroke petrol engine with help of neat sketch.

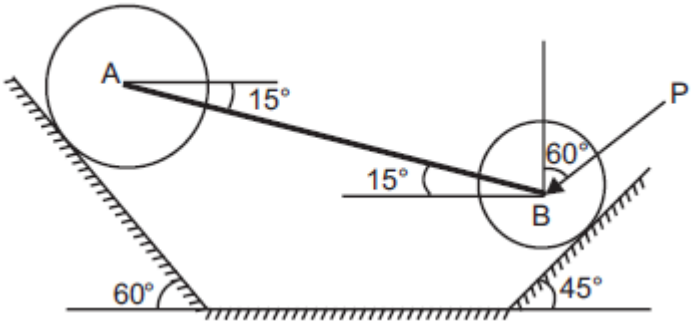
SECTION C

3. Attempt any *one* part of the following: 7 x 1 = 7

a) Locate the centroid of uniform wire shown in Fig. below. Note: portion AB is in x-z plane, BC in y-z plane and CD in x-y plane. AB and BC are semicircular in shape.



b) Two cylinders, A of weight 3000 N and B of weight 1000 N rest on smooth inclines as shown in Fig. below They are connected by a bar of negligible weight hinged to each cylinder at its geometric center by smooth pins. Find the force P to be applied as shown in the figure such that it will hold the system in the given position.



4. Attempt any *one* part of the following: 7 x 1 = 7

a) Find the forces in all members of the truss as shown in fig. below.

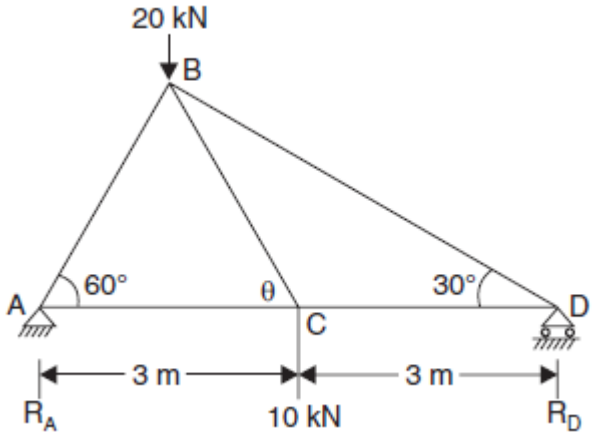
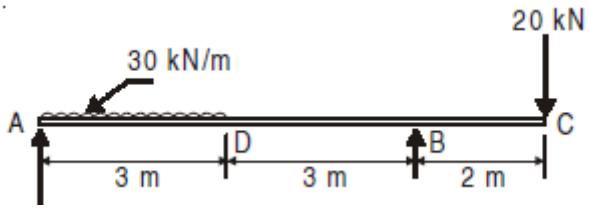


Figure.

b) Draw the shear force and bending moment diagram for the beam as shown in Figure below. Also find location of point of contraflexure.



5. Attempt any *one* part of the following: 7 x 1 = 7

a) State the assumptions made in deriving bending equation. Also derive bending equation.

b) State the assumption of Steady flow energy equations. Also write down the S.F.E.E for nozzle and compressor.

6. Attempt any *one* part of the following: 7 x 1 = 7

a) An ideal Otto cycle has a compression ratio of 8. At the beginning of the compression process, air is at 100 kPa and 17°C, and 800 kJ/kg of heat is transferred to air during the constant-volume heat-addition process. Accounting for the variation of specific heats of air with temperature, determine (*a*) the maximum temperature and pressure that occur during the cycle, (*b*) the network output, (*c*) the thermal efficiency, and (*d*) the mean effective pressure for the cycle.

b) Compare Otto cycle and diesel cycle.

7. Attempt any *one* part of the following: 7 x 1 = 7

a) What is the Rankine Cycle? Prove the Rankine Efficiency $\eta_{Rankine} = \frac{h_1 - h_2}{h_1 - h_3}$

b) Explain the Carnot theorem. Also write down the different corollaries of Carnot theorem.