**Q. Code:137250**

**Reg. No.** | | | | | | | | | | | | | |

# B.E. / B.TECH. DEGREE EXAMINATIONS, MAY 2024

Second Semester

## CE22202 – ENGINEERING MECHANICS FOR CIVIL ENGINEERS

*(Civil Engineering)*

**(Regulation 2022)**

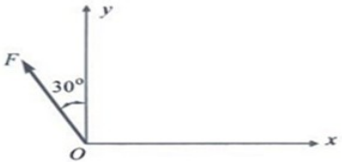
**TIME: 3 HOURS** **MAX. MARKS: 100**

| COURSE OUTCOMES | STATEMENT | RBT LEVEL |
|---|---|---|
| | Upon successful completion of the course, the students should be able to | |
| **CO 1** | Apply the concepts of mechanics to solve problems on statics of particles in two and three dimensions | **3** |
| **CO 2** | Solve problems on equilibrium of rigid bodies in two and three dimensions | **3** |
| **CO 3** | Evaluate centroid and moment of inertias of simple plane figures and composite plane areas | **3** |
| **CO 4** | Determine member forces in truss using different methods of analysis | **3** |
| **CO 5** | Draw the Shear force and Bending moment diagrams for determinate beams | **3** |

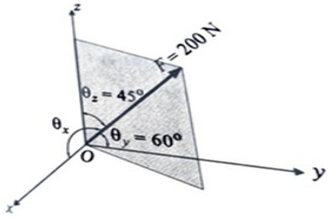
### PART- A (20 x 2 = 40 Marks)

(Answer all Questions)

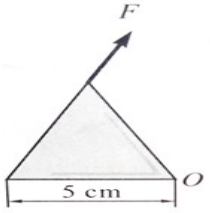
| | | CO | RBT LEVEL |
|---|---|---|---|
| **1.** | The vertical component of force F in the figure is 100 N upward through O. Find the force F and its horizontal component. | **1** | **2** |



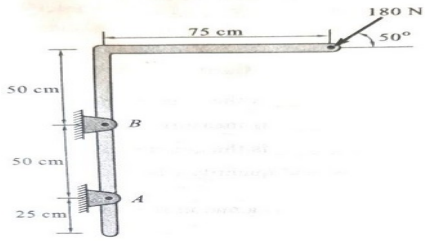

| | | | |
|---|---|---|---|
| **2.** | Resolve the given force shown in figure into component along x axis. | **1** | **2** |




| | | | |
|---|---|---|---|
| **3.** | Distinguish between coplanar concurrent and Coplanar non-concurrent system of forces with figures. | **1** | **2** |
| **4.** | Explain the Lami's theorem with figure | **1** | **2** |
| **5.** | Determine the moment about O of the force F=75 N acting along the side of equilateral triangle shown in figure having length of side 5 cm. | **2** | **2** |



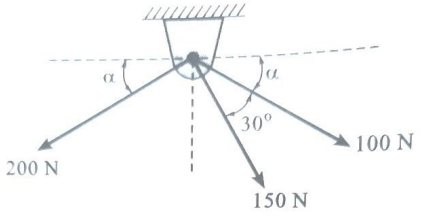
| | | | | |
|---|---|---|---|---|
| **6.** | Replace the force 180 N by an equivalent force couple system at A | **2** | **2** | |




| | | | | |
|---|---|---|---|---|
| **7.** | Explain the Varignon's theorem. | **2** | **2** | |
| **8.** | How do you find the x and y intercepts of resultant of non-concurrent force system? | **2** | **2** | |
| **9.** | Derive the centroid of a triangular area from first principles | **3** | **2** | |
| **10.** | Find the centroid of a T-section with a flange dimension 100 mm x20 mm and a web dimension 100 mmx20 mm. | **3** | **2** | |
| **11.** | Determine the moment of inertia of a hollow circular section whose external diameter is 8 cm and internal diameter is 6 cm about centroidal axis. | **3** | **2** | |
| **12.** | Find the moment of inertia of a square of side 'b' about ax axis through its centre of gravity. | **3** | **2** | |
| **13.** | Distinguish between deficient frame and a redundant frame. | **4** | **2** | |
| **14.** | Under what circumstances the method of section is preferred in truss member force analysis? | **4** | **2** | |
| **15.** | In a pin jointed frame the no. of joints are 6, find the no. of members for a perfect frame? | **4** | **2** | |
| **16.** | Sketch the truss which is statically indeterminate. | **4** | **2** | |
| **17.** | A simply supported beam of span 6 m carries a concentrated load of 12 kN at 2 m from the left support. What is the maximum shear force? | **5** | **2** | |
| **18.** | A cantilever beam of length 4m carries a concentrated load of 10 kN at 2m from the free end. Sketch the bending moment diagram. | **5** | **2** | |
| **19.** | Sketch the bending stress distribution in a cantilever beam indicating the nature of stresses. | **5** | **2** | |
| **20.** | A rectangular section 30 mm x 40 mm is subjected to a shear force of 12 kN. What is the maximum shear stress setup in the beam? | **5** | **2** | |

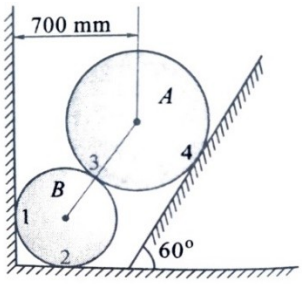
## PART- B (5 x 10 = 50 Marks)

| | | Marks | CO | RBT LEVEL |
|---|---|---|---|---|
| **21. (a)** | For the system shown determine (i) the required value of α if resultant of three forces is to be vertical and (ii) the corresponding magnitude of resultant. | **(10)** | **1** | **3** |

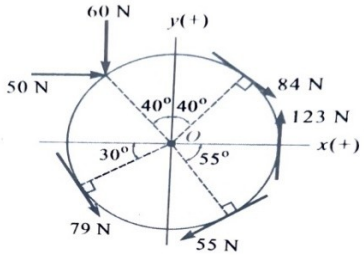



**(OR)**

| | | | | |
|---|---|---|---|---|
| **(b)** | Two spheres A and B of weight 1000 N and 750 N, respectively are kept as shown in the figure. Determine the reactions at all contact points 1, 2, 3 and 4. Radius of A= 400 mm and radius of B=300 mm. | **(10)** | **1** | **3** |

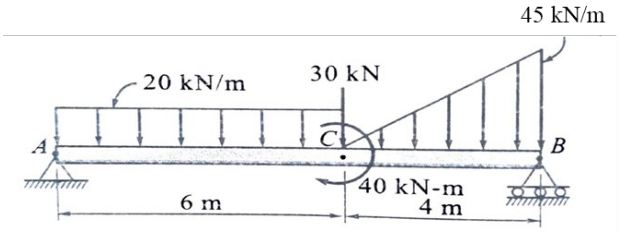



**22. (a)** Find the resultant of the force system shown in figure. Radius = 2.5 m. **(10)** **2** **3**

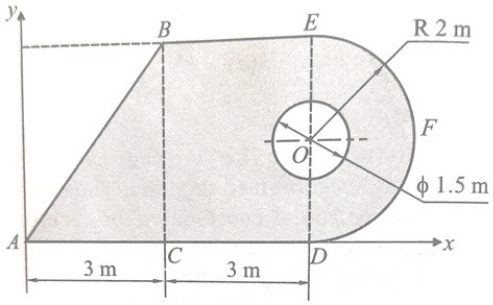



**(OR)**

**(b)** Calculate the support reactions for the beam shown in figure. **(10)** **2** **3**

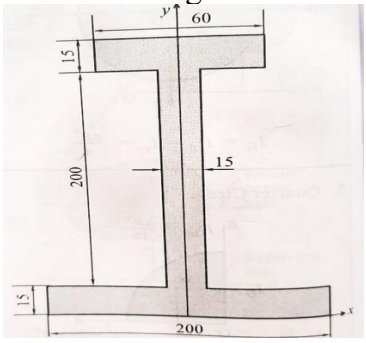



**23. (a)** Three plates ABC, BCDE and DEF are welded together as shown in figure. Circle of diameter 1.5 m is cut from the composite plate. Determine the centroid of the remaining area. **(10)** **3** **3**

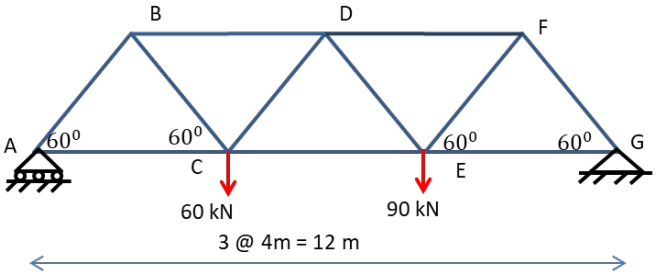



**(OR)**

**(b)** Find the centroid of the unequal I-section shown in figure and calculate Moment of Inertia (M.I.) about the centroidal x and y axis. Also find M.I. about base. All dimensions shown in figure are in mm. **(10)** **3** **3**

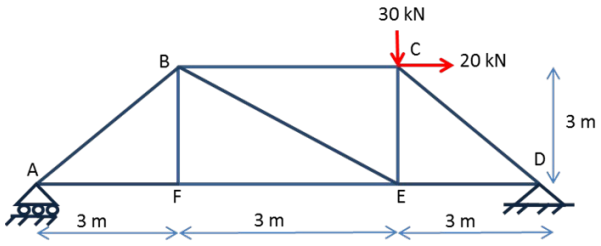


| | | | | |
|---|---|---|---|---|
| **24. (a)** | Find the forces in the members DF, DE and CE of the given truss using method of sections. | **(10)** | **4** | **3** |




**(OR)**

| | | | | |
|---|---|---|---|---|
| **(b)** | Determine the forces in the members BC, CE, CD of the truss shown in figure using method of joints. | **(10)** | **4** | **3** |




| | | | | |
|---|---|---|---|---|
| **25. (a)** | A simply supported beam of span 6 m carries loads of 30 kN & 24 kN at distances of 2 m and 3 m from the left end. Compute the reactions and draw the SFD and BMD. | **(10)** | **5** | **3** |

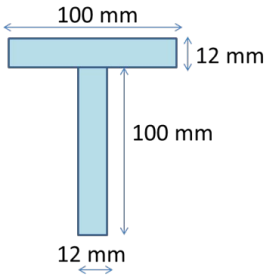
**(OR)**

| | | | | |
|---|---|---|---|---|
| **(b)** | A beam of rectangular cross section 200 mm deep and 100 mm wide is subjected to a pure sagging bending moment of 500 kNm. Determine the maximum bending stress in the beam. If the value of modulus of elasticity for the beam material is 200 kN/mm$^2$, find the radius of curvature of that portion of the beam. Also calculate the value of bending stress at a distance of 25 mm below the top surface of the beam. | **(10)** | **5** | **3** |

## PART- C (1 x 10 = 10 Marks)

(Q.No.26 is compulsory)

| | | Marks | CO | RBT LEVEL |
|---|---|---|---|---|
| **26.** | The cross section of a beam is a T-section as shown in Fig. The beam carries a constant shear of 25 kN. Sketch the shear stress distribution indicating the salient values on them. | **(10)** | **5** | **3** |

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