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**BTECH**  
**(SEM II) THEORY EXAMINATION 2021-22**  
**ENGG MECHANICS**

Time: 3 Hours

Total Marks: 100

Notes:

- Attempt all Sections and Assume any missing data.
- Appropriate marks are allotted to each question, answer accordingly.

SECTION-A	Attempt All of the following Questions in brief	Marks(10X2=20)
Q1(a)	State Varignon's theorem.	
Q1(b)	Explain coplanar non-concurrent forces. Also write the equilibrium conditions for it.	
Q1(c)	Explain coulomb's law of friction.	
Q1(d)	Explain the types of beams.	
Q1(e)	Differentiate between perfect, imperfect and redundant truss.	
Q1(f)	State and explain parallel axis theorem.	
Q1(g)	Where does the position of centre of gravity of semi-circular area lie?	
Q1(h)	Explain D'Alembert's principle.	
Q1(i)	State the Work-Energy principle.	
Q1(j)	What is the relationship between shear force and bending moment?	

SECTION-B	Attempt ANY THREE of the following Questions	Marks(3X10=30)
Q2(a)	The forces 20 N, 30 N, 40 N, 50 N and 60 N are acting at one of the angular points of a regular hexagon, towards the other five angular points, taken in order. Find the magnitude and direction of the resultant force.	
Q2(b)	A plane is loaded and supported as shown in Figure. Determine the nature and magnitude of the forces in the members 1, 2 and 3.	
Q2(c)	Two cylinders of diameters 100 mm and 50 mm, weighing 200 N and 50N, respectively are placed in a trough as shown in Figure. Neglecting friction, find the reactions at contact surfaces 1, 2, 3 and 4.	
Q2(d)	A solid cylindrical pulley of mass 800 kg, having 0.8 m, radius of gyration and 2 m diameter, is rotated by an electric motor, which exerts a uniform torque of 60 kN-m. A body of mass 3000 kg is to be lifted by a wire wrapped round the pulley. Find (i) acceleration of the body; and (ii) tension in the rope.	
Q2(e)	Draw the SFD and BMD of the overhanging beam loaded as shown in the figure.	



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SECTION-C	Attempt ANY ONE following Question	Marks (1X10=10)
Q3(a)	Classify the force systems. Also mention the equilibrium conditions for each of the force systems.	
Q3(b)	A body, resting on a rough horizontal plane, required a pull of 180 N inclined at 30° to the plane just to move it. It was found that a push of 220 N inclined at 30° to the plane just moved the body. Determine the weight of the body and the coefficient of friction.	

SECTION-C	Attempt ANY ONE following Question	Marks (1X10=10)
Q4(a)	Calculate the forces in each member of the following truss.	
Q4(b)	A cantilever beam of 1.5 m span is loaded as shown in Figure. Draw the shear force and bending moment diagrams.	

SECTION-C	Attempt ANY ONE following Question	Marks (1X10=10)
Q5(a)	Determine the coordinates of the centroid of the shaded area of the given figure.	
Q5(b)	Find the mass moment of inertia of a solid sphere about an axis passing through its centre.	

SECTION-C	Attempt ANY ONE following Question	Marks (1X10=10)
Q6(a)	A motor gives disk A an angular acceleration $\alpha=0.6t^2+0.75 \text{ rad/s}^2$ , where t is in seconds. If the initial velocity of the disk is 4 rad/s, determine the magnitude of the velocity and acceleration of block B when t=2 seconds. The radius of disk is given as 0.15m.	
Q6(b)	Two rough planes inclined at 30° and 15° to the horizontal and of the same height are placed back-to-back. Two bodies of masses of 15 kg and 5 kg are placed on the faces and connected by a string over the top of the planes. If the coefficient of friction be 0.3, find the resulting acceleration.	

SECTION-C	Attempt ANY ONE following Question	Marks (1X10=10)
Q7(a)	Derive the Bending Equation $(M/I)=(\sigma/y)=(E/R)$ .	
Q7(b)	A circular hollow shaft has to transmit 550kW power at 115 RPM. Allowable shear stress is 78 MPa. Find: (i) The required diameter of solid shaft, (ii) The diameters of hollow section such that internal diameter=0.75 x external diameter.	