**JEPPIAAR ENGINEERING COLLEGE**

Jeppiaar Nagar, Rajiv Gandhi Salai – 600 119

**DEPARTMENT OF MECHANICAL ENGINEERING**

# QUESTION BANK

**II SEMESTER**

GE-8292 ENGINEERING MECHANICS

**Regulation – 2017**

# JEPPIAAR ENGINEERING COLLEGE

## Vision of Institution

To build Jeppiaar Engineering College as an institution of academic excellence in technological and management education to become a world class university.

## Mission of Institution

- To excel in teaching and learning, research and innovation by promoting the principles of scientific analysis and creative thinking.
- To participate in the production, development and dissemination of knowledge and interact with national and international communities.
- To equip students with values, ethics and life skills needed to enrich their lives and enable them to meaningfully contribute to the progress of society.
- To prepare students for higher studies and lifelong learning, enrich them with the practical and entrepreneurial skills necessary to excel as future professionals and contribute to Nation's economy..

| | |
|---|---|
| **PO1** | **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| **PO2** | **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences. |
| **PO3** | **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations |
| **PO4** | **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |
| **PO5** | **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations. |
| **PO6** | **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice. |
| **PO7** | **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. |
| **PO8** | **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| **PO9** | **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. |
| **PO10** | **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions. |
| **PO11** | **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments. |
| **PO12** | **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change. |

**JEPPIAAR ENGINEERING COLLEGE**

**DEPARTMENT OF MECHANICAL ENGINEERING**

## VisionoftheDepartment

To create excellent professionals in the field of Mechanical Engineering and to uplift the quality of technical education on par with the International Standards.

## Department Mission

**1. To reinforce** the fundamentals of Science and Mathematics to Mechanical Engineering **and critically and relatively investigate co**mplex mechanical systems and processes.
**2.** To engage in the **production, expansion and practice** of advanced engineering applications through knowledge sharing activities by interacting with global communities and industries.
**3.** To **equip** students with **engineering ethics, professional roles, corporate social responsibility** and life skills and **apply** them for the betterment of society.
**4. To promote** higher studies and lifelong learning and entrepreneurial skills and **develop** excellent professionals for empowering nation's economy.

## PEO's

1. To **enrich** the technical knowledge of design, manufacturing and management of mechanical systems and **develop creative and analytical thinking** in research.
2. To **relate, strengthen and develop** the theoretical knowledge of the Mechanical Engineering by exhibiting various concepts applied through diverse industrial exposures and experts' guidance.
3. **Facilitate** the students to communicate effectively on complex social, professional and engineering activities with strict adherence to ethical principles.
4. **Create awareness for independent and life long learning and develop the ability to keep abreast of modern trends and adopt them for personal technological growth of the nation.**

## PSO's

1. To understand the basic concept of various mechanical engineering field such as design, manufacturing, thermal and industrial engineering.
2. To apply the knowledge in advanced mechanical system and processes by using design and analysis techniques.
3. To develop student's professional skills to meet the industry requirements and entrepreneurial skills for improving nation's economy stronger.

**COURSE OUTCOME**

| | |
|---|---|
| C114.1 | Illustrate the vectorial and scalar representation of forces and moments. |
| C114.2 | Analyze the rigid body in equilibrium. |
| C114.3 | Evaluate the properties of surfaces and solids. |
| C114.4 | Calculate dynamic forces exerted in rigid body. |
| C114.5 | Determine the friction and the effects by the laws of friction. |

**GE8292 ENGINEERING MECHANICS L T P C**

**OBJECTIVES:**

 To develop capacity to predict the effect of force and motion in the course of carrying out the
design functions of engineering.

**UNIT I BASICS AND STATICS OF PARTICLES 12**

Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces — Vectorial representation of forces – Vector operations of forces -additions, subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces –
Principle of transmissibility .

**UNIT II EQUILIBRIUM OF RIGID BODIES 12**

Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

**UNIT III PROPERTIES OF SURFACES AND SOLIDS 12**

Centroids and centre of mass– Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula –28 Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem –Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical andspherical solids from first principle – Relation to area moments of inertia.

**UNIT IV DYNAMICS OF PARTICLES 12**

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion -Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elasticbodies.

**UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 12**

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

**TOTAL : 60 PERIODS**

**OUTCOMES:**

 ability to explain the differential principles applies to solve engineering problems dealing with
force, displacement, velocity and acceleration.
 ability to analyse the forces in any structures.
 ability to solve rigid body subjected to dynamic forces.

**TEXT BOOKS:**

1. Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and
Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
2. Vela Murali, "Engineering Mechanics", Oxford University Press (2010)

**REFERENCES:**

1. Hibbeller, R.C and Ashok Gupta, "Engineering Mechanics: Statics and Dynamics", 11th Edition,
Pearson Education 2010.
2. Irving H. Shames and Krishna Mohana Rao. G., "Engineering Mechanics – Statics and
Dynamics", 4th Edition, Pearson Education 2006.
3. Meriam J.L. and Kraige L.G., " Engineering Mechanics- Statics - Volume 1, Dynamics- Volume
2", Third Edition, John Wiley & Sons,1993.
4. Rajasekaran S and Sankarasubramanian G., "Engineering Mechanics Statics and Dynamics",
3rd Edition, Vikas Publishing House Pvt. Ltd., 2005.
5. Bhavikatti, S.S and Rajashekarappa, K.G., "Engineering Mechanics", New Age International
(P) Limited Publishers, 1998.
6. Kumar, K.L., "Engineering Mechanics", 3rd Revised Edition, Tata McGraw-Hill Publishing
company, New Delhi 2008.

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**DEPARTMENT OF MECHANICAL ENGINEERING QUESTION BANK**

**SUBJECT : GE8292 ENGINEERING MECHANICS**

**YEAR /SEM: I /II**

| **UNIT I** | **BASICS AND STATICS OF PARTICLES** | **12** |
|---|---|---|
| Introduction – Units and Dimensions – Laws of Mechanics – Lami's theorem, Parallelogram and triangular Law of forces — Vectorial representation of forces – Vector operations of forces -additions, | | |

subtraction, dot product, cross product – Coplanar Forces – rectangular components – Equilibrium of a particle – Forces in space – Equilibrium of a particle in space – Equivalent systems of forces – Principle of transmissibility .

**PART – A**

**CO Mapping : C205.1**

| Q. No | Questions | BT Level | Competence | PO |
|---|---|---|---|---|
| 1 | Define scalar and vector quantities? (AUJUN'10,DEC'10,DEC'12) | BTL-1 | Remembering | PO1,PO2 |
| 2 | Define parallelogram law of forces. What is the use of this law? (AU JUN'12,DEC'11 | BTL-2 | Understanding | |
| 3 | What is resolution of a force? (AUJUN'09) | BTL-1 | Remembering | PO1,PO2 |
| 4 | State triangle law of forces.AUJUN'12,DEC 10 | BTL-2 | Understanding | PO1,PO2 |
| 5 | Define coplanar and non coplanar forces.AUDEC'09,JUN | BTL-1 | Remembering | PO1 |
| 6 | Define collinear and concurrent forces.AU MAY'11 | BTL-1 | Remembering | PO2,PO3 |
| 7 | State Lame's theorem.AU MAY'11 | BTL-2 | Understanding | PO1, PO2,PO3 |
| 8 | Write the conditions for equilibrium for a particle in space.AU DEC'11 | BTL-1 | Remembering | PO1, PO2,PO3 |
| 9 | What is principle of transmissibility of forces?AUJUN'09, DEC'11 | BTL-1 | Remembering | PO1,PO2 |
| 10 | What is cross product of two vectors? DEC 10 | BTL-1 | Remembering | PO1,PO3,PO4 |
| 11 | Sate the principle of transmissibility (apr./may2017) | BTL-2 | Understanding | PO1,PO2,PO4 |
| 12 | Find the resultant and direaction of Force F=3i-4j (apr./may2017) | BTL-5 | Evaluating | PO1,PO2 |
| 13 | State the principle of transmissibility. | BTL-2 | Understanding | PO1,PO2 |
| 14 | Find the resultant and direaction of force F=3i-4j | BTL-1 | Remembering | PO1,PO2 |
| 15 | Two forces 30N and 40N act at a point 'o'. The include angle between them is 60 deg.. Find the magnitude and the direaction of the resultant. | BTL-5 | Understanding | PO1,PO2 |
| 16 | What are the minimum requirement for eaqulibrium of a particle in space? | BTL-1 | Remembering | PO1,PO3,PO4 |
| 17 | Find the length of the line joning the origin with the point(2,1,-2) | BTL-4 | Analyzing | PO1,PO2,PO4 |
| 18 | State triangle law of forces. | BTL-2 | Understanding | PO1,PO2 |
| 19 | A vector F strts at point(2,-1,2) and passes through the point (-1,3,5). Find its unitvectors. | BTL-4 | Understanding | PO1,PO2 |
| 20 | State the principle of transmissibility. | BTL-6 | Analyzing | PO1,PO2 |
| | **PART – B** | | | |
| 1 | The four coplanar forces are acting at a point as shown in fig. Determine the resultant in magnitude and direction.AU JUN'10, | BTL-1 | Remembering | PO1,PO2,PO3 |

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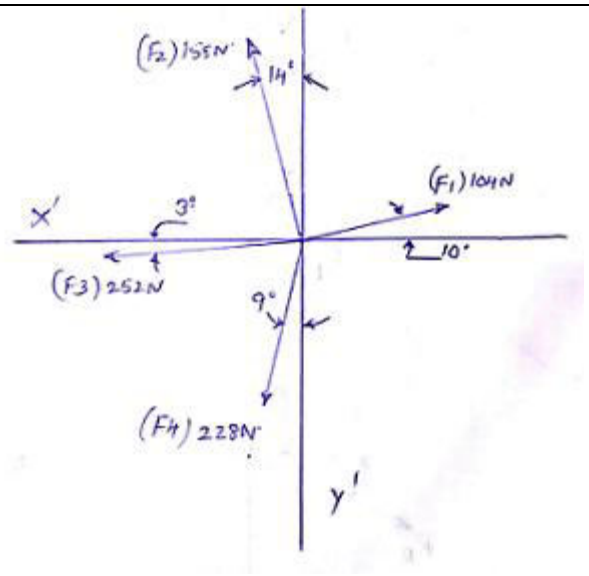
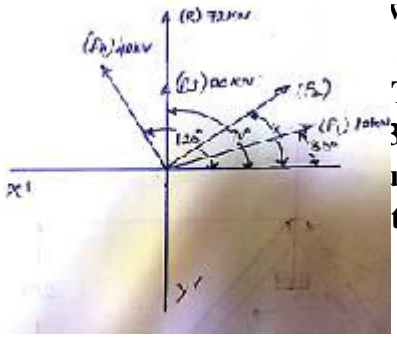
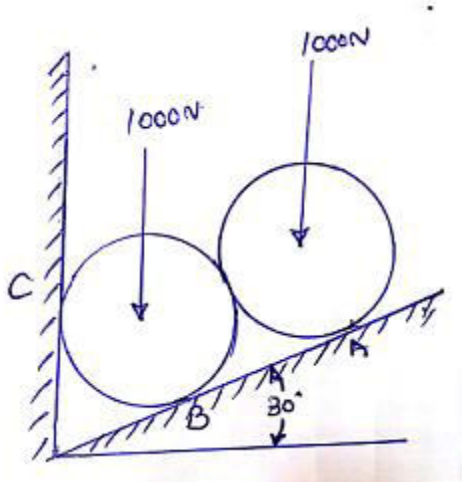
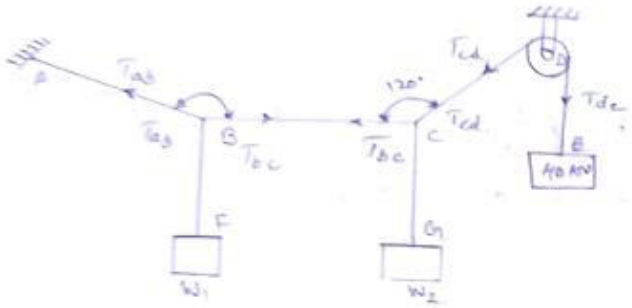
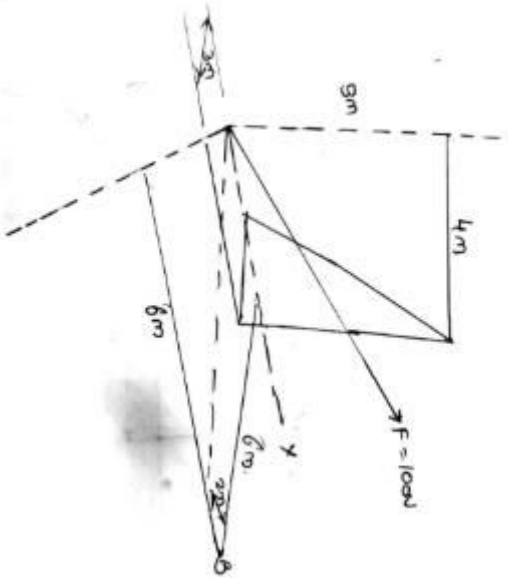
|---|---|---|---|---|
| |  | | | |
| 2 | **The resultant of four forces which are acting at w is along Y axis. and $F_4$ are 10kN, The angles made 30°, 90° and 120° ude and direction t is 72kN.AU**  | **BTL-5** | **Evaluating** | **PO1,PO2,PO3** |
| 3 | **Two identical rollers each of weight 1000N are supported by an inclined plane and a vertical wall as shown in fig below. Find the support reactions at points A,B&C. assume all surfaces to be smooth.AU MAY'11,JUN'12** | **BTL-5** | **Analyzing** | **PO1,PO2,PO3, PO5, PO6,PO9, PO12,** |

| | | | | |
|---|---|---|---|---|
| |  | | | |
| **4** | **For the tripod shown in figure below, the end points are in ZX plane. A body of weight 5000N is suspended from point P. find the force in each leg.AUMAY'11,JUN'12**<br>  <br>. | **BTL-5** | **Evaluating** | **PO1,PO2,PO3, PO4** |
| **5** | **A Force F with a magnitude of 100 N is applied at the orgin 'O' of the axes x-y-z as shown in Fig. The line of action of F passes through a point A whose co-ordinates are 3m, 4m and 5m. Determine (i) the x,y,z scalar components of F (ii) the projection of $F_{xy}$ on F on the x-y planes (iii) the projections of F along the line OB. (Anna University, Jan 2003)**<br>  | **BTL-5** | **Evaluating** | **PO1,PO2,PO3, PO4** |

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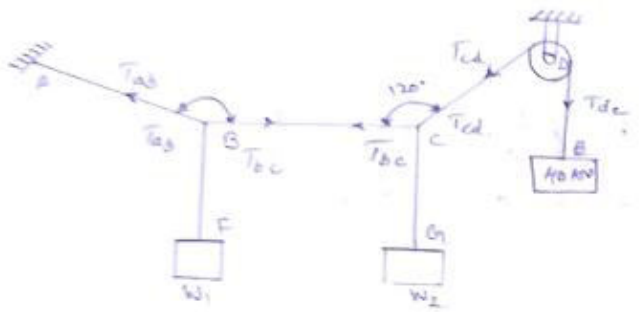
|---|---|---|---|---|
| 6 | **ABCDE is a light string whose end A is fixed. the weights W1 and W2 are attached to the string at B and C and the string passes round a small smooth wheel at D carrying a weight 40 KN at the free end E. in the position of equilibrium, BC is horizontal and AB and CD makes angle 150° and 120° with horizontal. Find (i) the tension in the string AB, BC, CD and DE. (ii) Magnitude of W1 and W2.**  | **BTL-4** | **Analyzing** | |

## UNIT II EQUILIBRIUM OF RIGID BODIES 12

Free body diagram – Types of supports –Action and reaction forces –stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis – Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions – Equilibrium of Rigid bodies in three dimensions

**PART – A**

**CO Mapping : C205.2**

| Q .No | Questions | BT Level | Competence | PO |
|---|---|---|---|---|
| 1 | **What is a rigid body?AU Dec'09,Jun'10** | **BTL-1** | **Remembering** | **PO2,PO3** |
| 2 | **What is a free body diagram?AU JUN'09,DEC'09, MAY'11,DEC'12** | **BTL-1** | **Remembering** | **PO1, PO2,PO3** |
| 3 | **List some types of supportsAU JUN'09,Dec'11** | **BTL-1** | **Remembering** | **PO1, PO2,PO3** |
| 4 | **List some types of loads.AU Dec'10,JUN'12** | **BTL-1** | **Remembering** | **PO1,PO2** |
| 5 | **List some types of beams based on supports.AU MAY'11** | **BTL-1** | **Remembering** | **PO1,PO3,PO4** |
| 6 | **What is a couple?AU JUN'10.** | **BTL-1** | **Remembering** | **PO1,PO2,PO4** |
| 7 | **What is a resultant force?AUJun'10,DEC'12** | **BTL-1** | **Remembering** | **PO1,PO2** |
| 8 | **What is equilibriant force? DEC'09** | **BTL-1** | **Remembering** | **PO1,PO2** |
| 9 | **Replace the force 50N acting in positive Y** | **BTL-4** | **Analyzing** | **PO1,PO2** |

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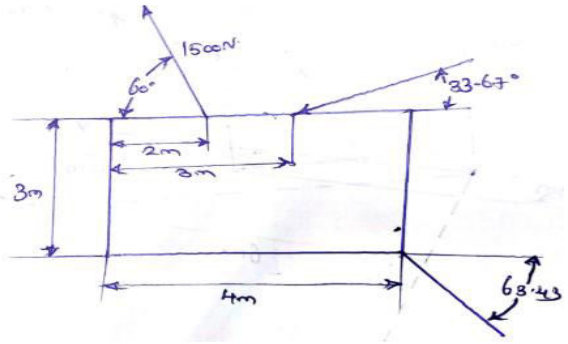
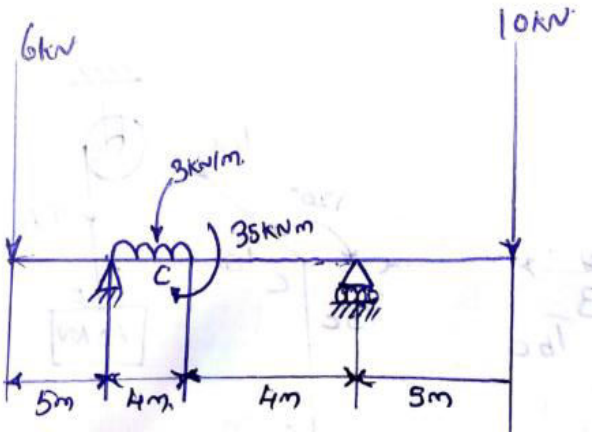
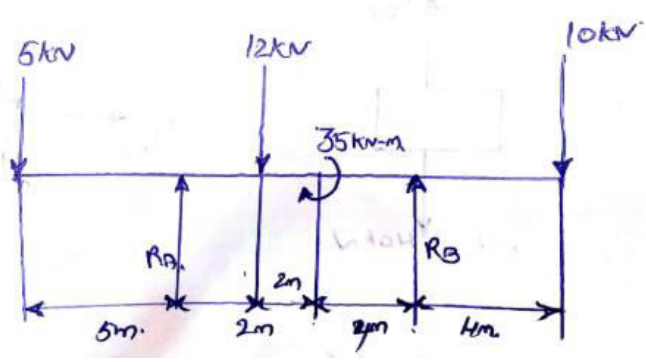
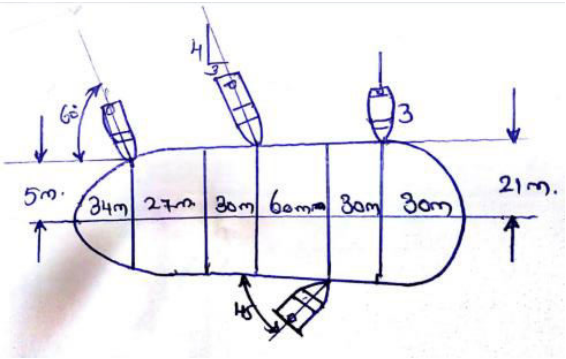
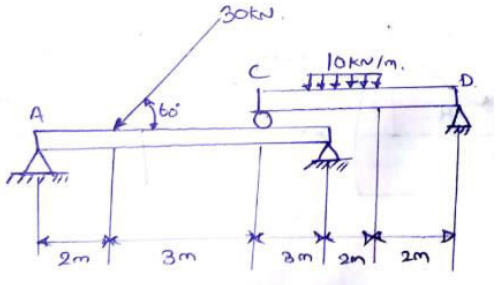
|---|---|---|---|---|
| | **direction on the origin about the point (5,0) by a force and moment. DEC'12** | | | |
| **10** | **Write the conditions for equilibrium for a rigid body in space. JUN'09** | **BTL-1** | **Remembering** | **PO1,PO4** |
| **11** | **State varignon's theorem. Nov/Dec 2012** | **BTL-2** | **Understanding** | **PO1,PO2** |
| **12** | Different between moment and couple. | **BTL-4** | **Analyzing** | **PO1,PO4** |
| **13** | A uniform ladder of weight W leans against a vertical wall. Assuming the contact surfaces as rough, draw the body diagram of the ladder with necessary assumptions. | **BTL-4** | **Evaluating** | **PO1,PO2,PO4** |
| **14** | How free body diagram is construction? | **BTL-1** | **Remembering** | **PO1** |
| **15** | State varigon's theorem. | **BTL-2** | **Understanding** | **PO1** |
| **16** | List the different supports used to support structures component | **BTL-2** | **Understanding** | **PO1** |
| **17** | Find the magnitude and location of the single equivalent force for a beam AB of length 8m having C at 3m from A sbject to the following forces. | **BTL-1** | **Remembering** | **PO1** |
| **18** | Two forces of 400N and -600N act at an angle 60 deg., to each other. Dtermine the resultant in magnitude and direaction. | **BTL-1** | **Understanding** | **PO1,PO4** |
| **19** | State parallel axis theorem. | **BTL-2** | **Understanding** | **PO1,PO2** |
| **20** | What the equations of equilibrium of a rigid body in two dimensions. | **BTL-1** | **Remembering** | **PO1,PO2** |
| | **PART – B & C** | | | |
| | | | | |
| **1** | **The figure below shows the coplanar system of forces acting on a flat plate. Determine (i) the resultant (ii) x and y intercepts of the resultant.AU Dec'10,JUN'12**   | **BTL-2** | **Understanding** | **PO1,PO2,** |
| **2** | **An overhanging beam is loaded as shown in fig. Find the support reactions of the beam** | **BTL-4** | **Analyzing** | **PO1,PO2** |

| | | | | |
|---|---|---|---|---|
| | **when a 35kNm couple acts at C as shown.AUDec'10,DEC'12**<br>  | | | |
| **3** | **A plate is acted upon by 3 forces and 2 couples as shown in fig. Determine the resultant of these force- couple system and find co-ordinate *x* of the point on the *x* – axis through which the resultant passes.(April/ May 2003)**<br>  | **BTL-5** | **Evaluating** | **PO1,PO2,PO4** |

| | | | | |
|---|---|---|---|---|
| 4 | **Four tug boats are used to bring an ocean liner to its pier. Each tugboat exerts a 5000 – N forces in the direction shown. Determine (a) the equivalent force – couple system at the foremast O, (b) the point on the hull where a single, more powerful tugboat should push to produce the same effect as the original four tugboats.(June 2010)**<br>  | **BTL-3** | **Evaluating** | **PO1,PO2,** |
| 5 | **Two beams AB and CD are shown in figure. A and D are hinged supports. B and C are roller supports.**<br>  | **BTL-1** | **Remembering** | **PO1, PO4** |
| | | | | |

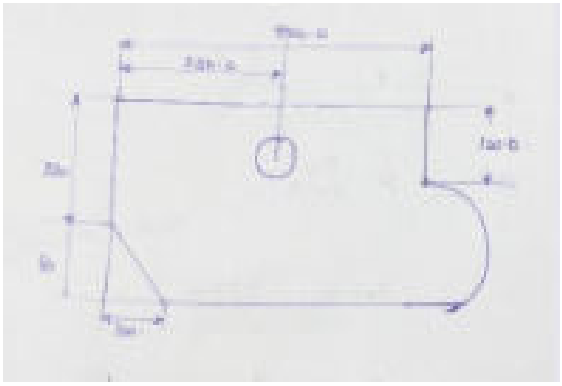
## UNIT III PROPERTIES OF SURFACES AND SOLIDS 12

Centroids and centre of mass– Centroids of lines and areas - Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula – 28 Theorems of Pappus - Area moments of inertia of plane areas – Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula – Parallel axis theorem and perpendicular axis theorem –Principal moments of inertia of plane areas – Principal axes of inertia-Mass moment of inertia –mass moment of inertia for prismatic, cylindrical and spherical solids from first principle – Relation to area moments of inertia.

**PART – A**

**CO Mapping : C205.3**

| Q.No | Questions | BT Level | Competence | PO |
|---|---|---|---|---|
| 1 | **What is centre of gravity?AU DEC'09 ,DEC'12** | **BTL-1** | **Remembering** | **PO1** |
| 2 | **What is centroid?AU DEC'09,DEC'10,JUN'12** | **BTL-1** | **Remembering** | **PO1** |
| 3 | **Write the formula for finding the centroid of a compound area about X and Y axes.AUDEC'11** | **BTL-1** | **Remembering** | **PO1** |
| 4 | **What is moment of inertia of an area?AU JUN'09,DEC'10,JUN'12** | **BTL-1** | **Remembering** | **PO1** |
| 5 | **Write the formula for finding moment of inertia about X and Y axis.AU JUN'10** | **BTL-1** | **Remembering** | **PO1,PO4** |
| 6 | **What is parallel axes theorem for moment of inertia?AU MAY'11** | **BTL-1** | **Remembering** | **PO1** |
| 7 | **What is perpendicular axes theorem for moment of inertia?AU MAY'11,DEC'12** | **BTL-1** | **Remembering** | **PO1** |
| 8 | **What is product of inertia?AU JUN'10,DEC'11** | **BTL-1** | **Remembering** | **PO1,PO2** |
| 9 | **What is principal moment of inertia?AU JUN'09** | **BTL-1** | **Remembering** | **PO1,PO4** |
| 10 | **What is mass moment of inertia?DEC 12** | **BTL-1** | **Remembering** | **PO1,PO2** |
| 11 | **Determine the centroid of the rectangle lamina 55 mm × 25 mm.** | **BTL-5** | **Evaluating** | **PO1** |
| 12 | **Define Radius of Gyration. Apr/May 2015.** | **BTL-1** | **Remembering** | **PO1,PO2** |
| 13 | When the equation of equilibrium of a rigid body in two dimensions. | **BTL-3** | **Evaluating** | **PO1,PO2** |
| 14 | When will the centroid and center of mass coincides? | **BTL-5** | **Evaluating** | **PO1,PO2** |
| 15 | Differentiate between center of gravity and centroid. | **BTL-4** | **Analyzing** | **PO1** |
| 16 | State parallel axis theorem as applied to area moment of Inertia. | **BTL-2** | **Understanding** | **PO1** |
| 17 | State pappus-guldinus theorem. | **BTL-2** | **Analyzing** | **PO1,PO2,PO4** |

| | | | | |
|---|---|---|---|---|
| **18** | When will the product of inertia oa an area become Zero? | **BTL-1** | **Remembering** | **PO1** |
| **19** | A right angled traiangle of base 3m and height 4m is revolved edge. Compute the volume of the solid generated. | **BTL-2** | **Understanding** | **PO1** |
| **20** | Write an expression for the redius of gyration of an area. | **BTL-1** | **Remembering** | **PO1,PO2** |
| | **PART – B & C** | | | |
| **1** | **Determine the position of the centroid for the section with respect to the axes shown in fig. AU JUN'10,DEC 12**  | **BTL-4** | **Analyzing** | **PO1,PO2,PO4** |
| **2** | **Locate the centroid of the plane area shown in figAU JUN'12**  | **BTL-2** | **Understanding** | **PO1,PO2, PO3,PO4** |
| **3** | **Calculate the centroidal moment of inertia of the shaded area shown in figureAU DEC'10,JUN'12** | **BTL-5** | **Evaluating** | **PO1,PO2,PO3** |

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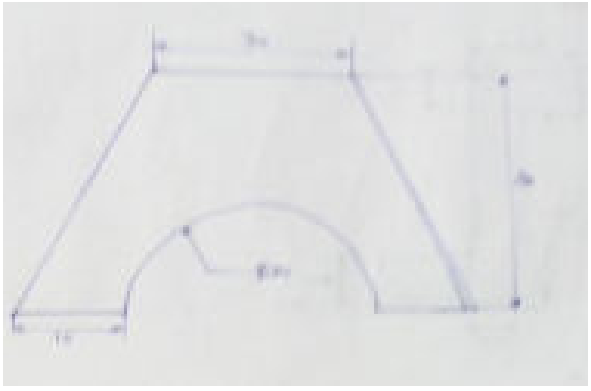
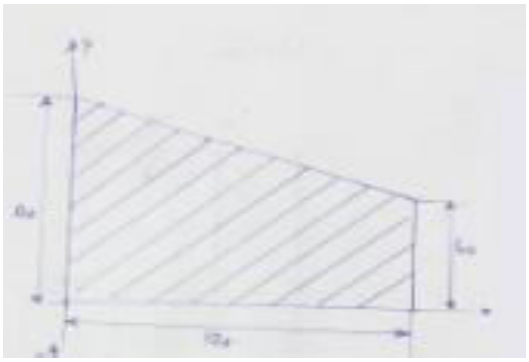
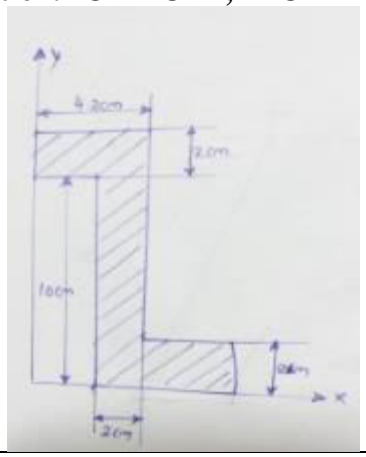
| |  | | | |
| **4** | **Find the product of inertia about OX and OY axes of the trapezium shown in figure.AUDEC'12, JUN'10**<br>  | **BTL-5** | **Evaluating** | **PO1,PO2, PO3** |
| **5** | **Evaluate the moment of inertia of unequal Z section as shown in fig about the centroidalaxes .also find the product moment of inertia and principal moment of inertia at the centroid of section.AU DEC'11,DEC'12**<br>  | **BTL-5** | **Evaluating** | **PO1,PO2, PO3,PO4** |

| UNIT IV | DYNAMICS OF PARTICLES | 12 |
|---|---|---|

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion -Newton's laws of motion – Work Energy Equation– Impulse and Momentum – Impact of elastic bodies.

**PART – A**

**CO Mapping : C205.4**

| Q. No | Questions | BT Level | Competence | PO |
|---|---|---|---|---|
| 1 | **What is kinematics?AU,Dec'09** | **BTL-1** | **Remembering** | **PO1,PO2** |
| 2 | **Write down the equations of motion of a body.AU,Jun'09** | **BTL-1** | **Remembering** | **PO1,PO2** |
| 3 | **List the types of motion.AU,Jun'10,Jun'12** | **BTL-1** | **Remembering** | **PO1** |
| 4 | **Define rectilinear, curvilinear motion.AU,Apr'11,DEC** | **BTL-4** | **Analyzing** | **PO1,PO2** |
| 5 | **What is relative motion? and how is position of a body expressed in relation with other body. AU,Dec'09** | **BTL-1** | **Remembering** | **PO1** |
| 6 | **A body a moves with a constant velocity of 5m/s along positive x axis and body B moves along positive Y axis with a constant velocity of 3m/s. Determine the relative velocity of A with respect to B. AU,Jun'10, Jun'12** | **BTL-5** | **Remembering** | **PO1,PO2** |
| 7 | **State Newton's second law of motion.( De Alembert's principle)AU,Dec'11** | **BTL-2** | **Understanding** | **PO1** |
| 8 | **Define projectile. Apr/ May 2015**. | **BTL-1** | **Analyzing** | **PO1** |
| 9 | **Define impulse & momentum.** | **BTL-1** | **Evaluating** | **PO1,PO2** |
| 10 | **Define co-efficient of restitution. May/June 2012**. | **BTL-1** | **Remembering** | **PO1,PO2** |
| 11 | **State law of conservation of momentum.** | **BTL-2** | **Understanding** | **PO1,PO4** |
| 12 | **A particle moves along X axis and its position is expressed as $x=3.5t^3-7t^2$ where x is in meters and t is in seconds. Determine** | **BTL-3** | **Remembering** | **PO1,PO2** |
| 13 | **A train running at 80km/h is brought to a standing halt after 50 seconds. Find the retardation.** | **BTL-5** | **Remembering** | **PO1** |
| 14 | **What is dynamics equilibrium?** | **BTL-1** | **Remembering** | **PO1** |
| 15 | A particle is projected into space at an angle of 30 degree to the horizontal at a velocity of 40m/s. Find the max. height reached by the projectile. | **BTL-5** | **Analyzing** | **PO1,PO3** |

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| **16** | Distinguish between perfectly plastic impact and perfectly elastic impact. | **BTL-4** | **Analyzing** | **PO1** |
| **17** | Define Work Energy Principle. | **BTL-1** | **Remembering** | **PO1,PO3** |
| **18** | A motorist is travelling at 90kmph, when he observes a traffic light 250m ahead turns red. The traffic light is timed to stay red for 12 sec. If the motorist wishes to pass the light without stopping, just as it turns green, Determine<br>(a) The required uniform deceleration of the motor and<br>(b) The speed of the motor as it passes the traffic light. | **BTL-5** | **Analyzing** | **PO1,PO3** |
| **19** | Define Newton's law of motion. | **BTL-4** | **Analyzing** | **PO1** |
| **20** | Give the equation of work energy for a rectilinear motion. | **BTL-2** | **Analyzing** | **PO1** |
| | **PART – B & C** | | | |
| **1** | **The acceleration of a particle moving along a straight line is defined by a=8-x; The particle starts from rest at t=0 and origin x=0. Determine (a) Velocity of the particle when x=10m (b) The position of particle when velocity becomes zero. (c) Velocity of a particle when acceleration becomes zero.AU,Dec'10,Jun'12**<br><br>*Operation* / *Time (min)* / *Labour cost/hr (Rs.)* / *Shop overheads/hr (Rs.)*<br>Moulding and pouring 15 20 60<br>Shot blasting 5 10 40<br>Fettling 6 10 40 | **BTL-4** | **Analyzing** | **PO1,PO2, PO3** |
| **2** | **A stone is thrown up vertically from the foot of a tower of height 22m with a velocity of 12m/s. St the same time, another stone is dropped from the top of the tower. Find the height at which the two stones cross each other.** | **BTL-5** | **Evaluating** | **PO1,PO2** |

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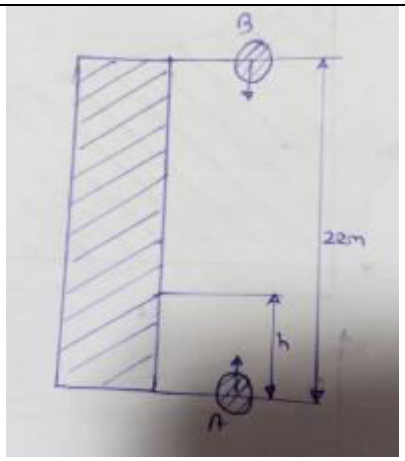
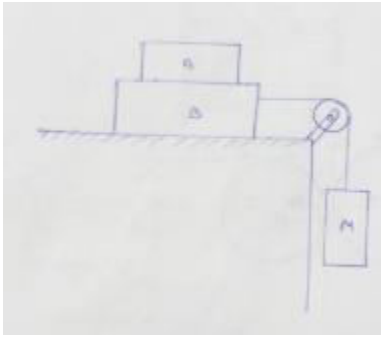
| |  | | | |
| 3 | **From the top of a 60m tower, a bullet os fired at an angle of 60° with the horizontal, with a velocity of 120m/s. Calculate the maximum height attained by the bullet and the time of its travel when it strikes the ground.AU,Apr'11**<br>  | **BTL-5** | **Evaluating** | **PO1,PO2, PO4** |
| 4 | **Two blocks A and b of masses 3 and 6kg respectively are placed one above the other on a horizontal table and connected to a suspended mass M through a frictionless pulley as shown in fig. The coefficient of static friction between A and B is 0.3 and the coefficient of kinetic friction between block B and table is 0.2. Find the maximum mass of the block M in order that b accelerates over the table without A slipping over B.AU,Apr'11,Dec'12**<br>  | **BTL-5** | **Evaluating** | **PO1,PO2, PO3,PO4** |

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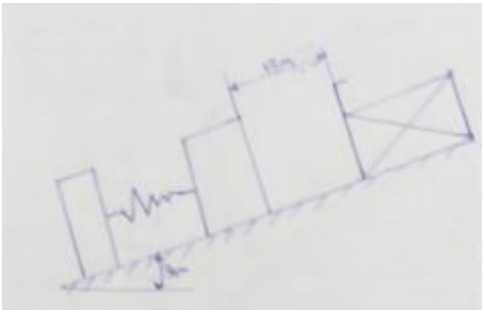
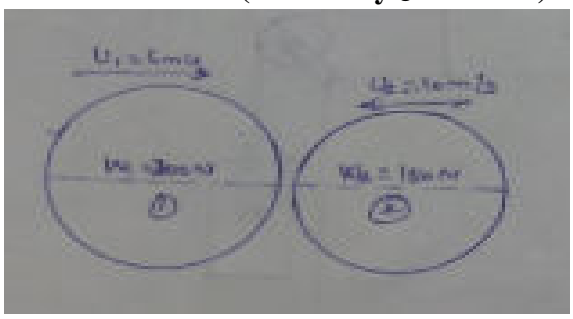
| **5** | **A block of mass 60 Kg moving down a 35° inclined plane from rest. After moving 1.3m, the block strikes a spring whose modulus is 20N/mm. Determine (i) Maximum deformation of the spring (ii) Maximum velocity of the block. Take μ as 0.15.**<br>  | **BTL-5** | **Evaluating** | **PO1,PO2** |
| **6** | **Direct central impact occurs between 300 N body moving to the right with the velocity of 6 m/s and 150 N body moving to the left with the velocity of 10 m/s. Find the velocity of each body after impact if the coefficient of restitution is 0.8. (AU – May/June 2010)**<br>  | **BTL-4** | **Analyzing** | **PO1,PO2, PO3** |
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## UNIT V FRICTION AND ELEMENTS OF RIGID BODY DYNAMICS 12

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

**PART – A**

**CO Mapping : C205.5**

| Q.No | Questions | BT Level | Competence | PO |
|---|---|---|---|---|
| 1 | Statethelawsofdry(coloumb)friction.(AU,Jun' 10) | BTL-5 | Remembering | PO1 |
| 2 | Definecoefficientof kineticfriction.(AU,Jun'09,Dec12) | BTL-1 | Understanding | PO1,PO2 |
| 3 | What iscoloumbfriction?(AU,Jun'09) | BTL-1 | Remembering | PO1,PO3 |
| 4 | Define:coefficient ofstaticfriction.(AU,Dec'10,Apr'11) | BTL-1 | Remembering | PO1 |
| 5 | List out the different types of friction. Whatiscoefficientofstaticfriction?(AU,Dec'09) | BTL-2 | Understanding | PO1 |
| 6 | When dowe saythat themotionofabodyisimpending?(AU,Dec'11,Dec'12,Jun'12) | BTL-1 | Remembering | PO1 |
| 7 | What isgeneralplane motion? (AU,Jun'10,Apr'11) | BTL-1 | Analyzing | PO1,PO2 |
| 8 | Arigidbodyisacteduponbyaforceof100N,thevelocityofbodychangesfrom15m/sto25m /sduringaperiodof50s.Findthemassofbodyandthedistancemovedbythebody during thetime ofinterval.(AU,Dec'09) | BTL-2 | Understanding | PO1,PO12 |
| 9 | Arigidbodyrotatesaboutafixedaxis.Writethe expressionforangularvelocitywhe nthe rotationisuniformlyaccelerated.(AU, Dec'11) | BTL-2 | Understanding | PO1,PO12 |
| 10 | Define angle of repose. Apr/May 2015 | BTL-1 | Understanding | PO12 |
| 11 | Explain the rolling resistance. | BTL-1 | Understanding | PO1 |

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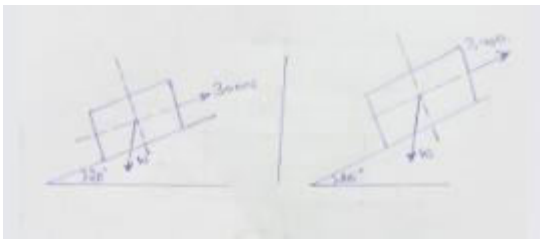
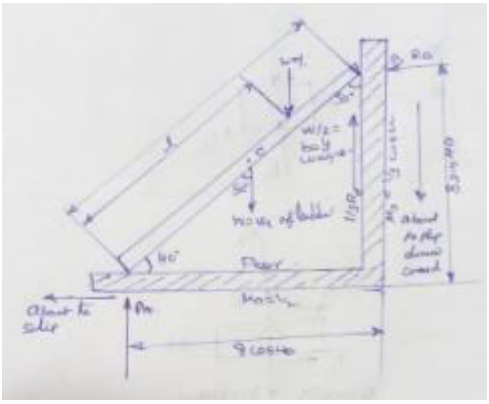
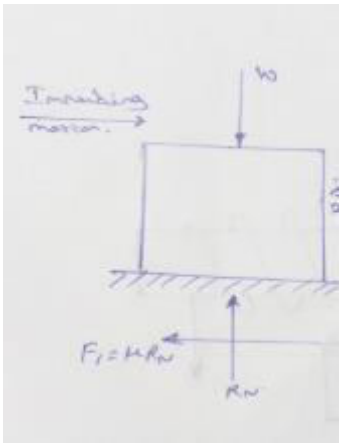
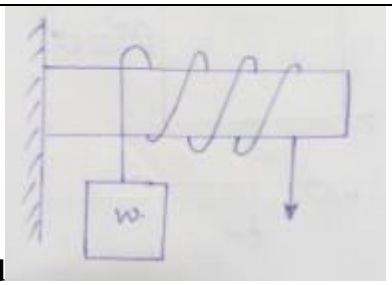
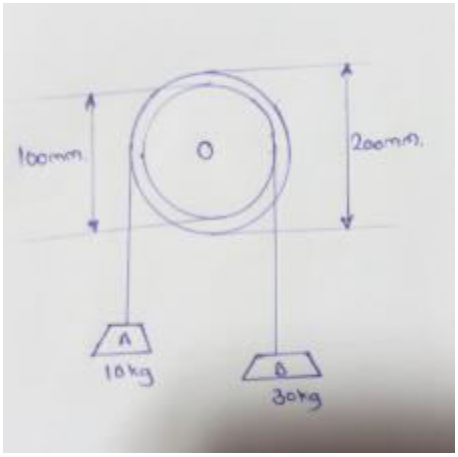
| **12** | Define limiting friction | **BTL-2** | **Understanding** | **PO1,PO3** |
| **13** | **Define instantaneous center of roation.** | **BTL-2** | **Understanding** | **PO1** |
| **14** | What is dry friction? | **BTL-2** | **Understanding** | **PO1** |
| **15** | What is general plane motion? Give one example. | **BTL-1** | **Remembering** | **PO1** |
| **16** | **What is angle of repose?** | **BTL-1** | **Remembering** | **PO1** |
| **17** | A motor bike wheel of radius 80cm is moving along a straight road with a speed of 60 km/hr. Find the angular speed of the wheel. | **BTL-4** | **Analyzing** | **PO1** |
| **18** | What is angle of repose? | **BTL-1** | **Remembering** | **PO1** |
| **19** | A wheel of radius 50cm subject to a load of 300N rolls on a level ground at constant speed. If the wheel is pushed by a tractive force of 60N applied horizontally of rolling resistance. | | | |
| | **PART – B** | | | |
| **1** | **A force of 300 N is required just to move a block up a plane inclined at 20° to the horizontal, the force being applied parallel to the plane of figure 15**<br>**(a). If the inclination of the plane is increased to 25°, the force required just to move the block up is 340 N, (the force is acting parallel to the plane). Determine the weight of the block and the coefficient of friction.**<br>  | **BTL-4** | **Analyzing** | **PO1,PO3** |
| **2** | **A 8m long ladder rests against a vertical wall making an angle of 50° with the wall and resting on a floor, If a boy, whose weight is one half that of the ladder climbs it, at what** | **BTL-5** | **Evaluating** | **PO1,PO2,PO3** |

| | | | | |
|---|---|---|---|---|
| | **distance along the ladder will he be, when the ladder is about to slip? The coefficient of friction between the ladder and the wall is 1/3 and that between the ladder and the floor is 1/2. (Nov/Dec 2012)**<br>  <br> | | | |
| **3** | **A pull of 250 N inclined at 30° to the horizontal plane is required just to move a body kept on a rough horizontal plane. But the push required just to move the body is 300 N. If the push is inclined at 30° to the horizontal, find the weight of the body and the coefficient of friction. (May/June 2009 – AU)**<br>  <br> | **BTL-2** | **Understanding** | **PO1,PO3,PO12** |
| **4** | **A block of weight 1290 N rests on a horizontal surface and supports another block of weight 570 N on top of it as shown in fig. Find the force P applied to the lower block that will be necessary to cause slipping to impend. Coefficient of friction between block (1) and (2) is 0.25 and Coefficient of friction between** | **BTL-2** | **Understanding** | **PO1,PO3,PO12** |

| | | | | |
|---|---|---|---|---|
| | **block (1) and**   | | | |
| **5** | **Twomassesof30kgand10kgaretiedtothetwoend sofalightstringpassingovera compositepulleyofradiusofgyrationas70mman dmass4kgasshowninFigure below.Find the pulls inthe two parts ofthe stringand the angularacceleration of thepulley.**   | **BTL-6** | **Creating** | **PO1,PO2, PO3,PO12** |