UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
SEPTEMBER 2014 SESSION

SUBJECT CODE : NMB11103
SUBJECT TITLE : ENGINEERING MECHANICS 1
LEVEL : BACHELOR
TIME / DURATION : 9.00 AM – 12.00 PM
                  (3 HOURS)
DATE : 2 JANUARY 2015

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answers should be written in blue or black ink except for sketching, graphic and illustration.
5. This question paper consists of FIVE (5) questions. Answer FOUR (4) questions only.
6. Answer all questions in English.
7. Shapes and Geometric Tables is appended

THERE ARE 5 PAGES OF QUESTIONS AND 4 PAGES OF APPENDIX, EXCLUDING THIS PAGE.
QUESTION 1

(a) Three forces act on the bracket (Figure 1). Determine the magnitude and direction \( \theta \) of \( F_1 \) so that the resultant force is directed along the positive \( x' \) axis and has a magnitude of 1 kN.

(b) Express each force acting on the bracket in Figure 2 as a Cartesian vector. Determine the magnitude and coordinate direction angles of the resultant force acting on the bracket.
QUESTION 2

A 450N load is suspended from the hook shown (Figure 3) below. If the load is supported by two cables and a spring having a stiffness $k = 8 \text{ kN/m}$, determine the force in the cables and the stretch of the spring for equilibrium. Cable AD lies in the x-y plane and cable AC lies in the x-z plane. Sketch the free body diagram showing all forces.

Figure 3

(25 marks)
QUESTION 3

(a) Replace the loading on the frame (figure 4) by a single resultant force. Specify where its line of action intersects member AB, measured from A.

Figure 4

(b) The semi cylinder of mass $m$ and radius $r$ lies on the rough inclined plane. If the inclination $\theta = 15^\circ$, determine the smallest coefficient of static friction which will prevent the semi cylinder from slipping.

Figure 5

(13 marks)

(12 marks)
Determine the force in members EF, EP, LK, CD and CM of the Baltimore bridge truss (Figure 6) and state if the members are in tension or compression. Also, indicate all zero-force members.
Question 5

(a) Determine the mass moment of inertia of the overhung crank (Figure 7) about the x axis. The material is steel having a density of \( \rho = 7.85 \text{ Mg/m}^3 \).

(b) Locate the centre of gravity of the volume with a radius of 2 m as shown (Figure 8). The material is homogeneous. The volume can be describe by the curve \( y^2 = 2z \).
<table>
<thead>
<tr>
<th>Centroid Location</th>
<th>Centroid Location</th>
<th>Area Moment of Inertia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circular arc segment</td>
<td>Cicular sector area</td>
<td>$I_x = \frac{1}{8} \pi r^4$</td>
</tr>
<tr>
<td>Quarter &amp; semicircle arcs</td>
<td>Quarter circle area</td>
<td>$I_x = \frac{1}{8} \pi r^4$</td>
</tr>
<tr>
<td>Trapezoidal area</td>
<td>Semicircular area</td>
<td>$I_x = \frac{1}{4} \pi r^4$</td>
</tr>
<tr>
<td>Semiparabolic area</td>
<td>Circular area</td>
<td>$I_x = \frac{1}{12} bh^3$</td>
</tr>
<tr>
<td>Exparabolic area</td>
<td>Rectangular area</td>
<td>$I_y = \frac{1}{12} bh^3$</td>
</tr>
</tbody>
</table>
Table 2: Centre of Gravity and Mass Moment of Inertia of Homogenous Solids
<table>
<thead>
<tr>
<th>Support Type</th>
<th>Free Body Diagram</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cable</td>
<td><img src="#" alt="Cable Support" /></td>
</tr>
<tr>
<td>Roller</td>
<td><img src="#" alt="Roller Support" /></td>
</tr>
<tr>
<td>Weightless Link</td>
<td><img src="#" alt="Weightless Link" /></td>
</tr>
<tr>
<td>Fixed Support</td>
<td><img src="#" alt="Fixed Support" /></td>
</tr>
<tr>
<td>Roller or Pin in Slot</td>
<td><img src="#" alt="Roller or Pin in Slot" /></td>
</tr>
<tr>
<td>Rocker</td>
<td><img src="#" alt="Rocker" /></td>
</tr>
<tr>
<td>Smooth Contacting Surface</td>
<td><img src="#" alt="Smooth Contacting Surface" /></td>
</tr>
</tbody>
</table>

Table 3: Support for Rigid Bodies 2D

**Thin Ring**

\[ I_{xx} = I_{yy} = \frac{1}{2} m r^2 \quad I_{zz} = m r^2 \]

**Slender Rod**

\[ I_{xx} = I_{yy} = \frac{1}{12} m l^2 \quad I_{x'y'} = I_{y'x'} = \frac{1}{3} m l^2 \quad I_{z'z'} = 0 \]
Table 4: Support for Rigid Bodies 3D

- **(7)** Member pin connected to collar on smooth rod
- **(8)** Smooth pin or hinge
- **(9)** Member fixed connected to collar on smooth rod

**Notes:**
- Support types illustrated:
  - Cable
  - Smooth surface support
  - Roller
  - Ball and socket
  - Single journal bearing
  - Single journal bearing with square shaft
  - Single thrust bearing
  - Single smooth pin
  - Single hinge
  - Fixed support