UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2012/2013

COURSE NAME	:	ENGINEERING MECHANICS
COURSE CODE	:	BDU 10503
PROGRAMME	:	1, 2 & 3BDC/ 1 & 2 BDM
EXAMINATION DATE	:	JUNE 2013
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS. **TWO (2)** QUESTIONS FROM **SECTION A** AND **TWO (2)** QUESTIONS FROM **SECTION B**

THIS QUESTION PAPER CONSISTS OF NINE (9) PRINTED PAGES

SECTION A

INSTRUCTION : ANSWER TWO (2) QUESTIONS ONLY.

Q1 (a) Give your reason why Newton's Second and Third Laws are important in aviation.

(4 marks)

(b) Determine the magnitude and coordinate direction angles of the resultant force acting on the bracket in Figure 1(a).

(11 marks)

(c) The horizontal 30N force acts on the handle of the wrench as shown in Figure Q1(b). Determine the moment of this force about point O. Specify the coordinate direction angles α, β and γ of the moment axis.

(10 marks)

Q2 (a) Using Figure Q2(a), determine the tensions developed in wires CD,CB and AB and also the angle required for equilibrium of the 50kg cylinder E and the 100kg cylinder F.

(10 marks)

(b) The jib crane is supported by a pin at C and rod AB as shown in Figure Q2(b). The rod can withstand a maximum tension of 45 kN. If the load,D, is 10Mg, with its center of mass located at G, determine its maximum allowable distance, x and the corresponding horizontal and vertical components of reaction at C.

(5 marks)

(c) The shaft assembly in Figure Q2(c) is supported by two smooth journal bearings A and B and a short link DC. If a moment of 250Nm is applied to the shaft, determine the components of force reaction at the journal bearings and the force in the link. The link lies in a plane parallel to the y–z plane and the bearings are properly aligned on the shaft.

(10 marks)

Q3 (a) Determine the greatest force P that can be applied to the truss in Figure Q3(a) so that none of the members are subjected to a force exceeding either 1.5kN in tension or 1kN in compression.

(12 marks)

(b) Using Figure Q3(b), determine the force in members ED, EH, GH and DC of the truss, and state if the members are in tension or compression.

(13 marks)

SECTION B

INSTRUCTION : ANSWER TWO (2) QUESTIONS ONLY.

Q4 A fighter plane is in fighting combat with its position vector as:

$$\mathbf{r} = (1.5t^2 + 3t)\mathbf{i} + (1.5t - t^2)\mathbf{j} + 1.2t^2\mathbf{k} \quad [\text{m}]$$

where t is in seconds and $(\mathbf{i},\mathbf{j},\mathbf{k})$ are unit vectors along x,y,z coordinate axes. $\mathbf{r}$ is measured from the origin with the z axis directed vertically upward.

(a) Determine the (x, y, z) projections of the velocity,$\mathbf{v}$ and the acceleration, $\mathbf{a}$ at t= 2 s.

(10 marks)

(b) Determine the speed, $\mathbf{v}$ of the fighter at t = 2 s.

(5 marks)

(c) Determine the distance traveled by the fighter in the interval from t = 0 to t =2 s.

(10 marks)

Q5 An Airbus 380 with maximum take-off weight is ready to take-off from the runway 10. At full throttle, the plane starts to roll-off.

(a) Find the lift-off speed for the plane.

(10 marks)

(b) The acceleration, time and runway length for the take-off.

(5 marks)

(c) The runway length needed if there is 80km/h head wind.

(10 marks)

Take the maximum take-off weight = 500,000 kg; runway coefficient of friction = 0.4; operating on 4 engines with 1,000,000 N thrust per engine. The wing area = 300 m^2 with lift coefficient of 3.6 and drag coefficient = 1.2. The density of air = 1.225 kg/m^3. [Hint: Take average ground roll speed in calculating the aircraft drag].

Q6 In Figure Q6, the weights of M, N and K are 160, 320 and 960 kg respectively. The weight and friction of pulleys and cables are negligible. The coefficient of frictions between M, N, K and the planes is 0.02. M, N and K are released from rest.

(a) Determine whether the MNK system will slide or not and if it slides in which direction.

(10 marks)

(b) Determine the acceleration of sliding.

(3 marks)

(c) Determine the velocity of the system 10 seconds after it started to slide.

(2 marks)

(d) If N and K are being replaced by an electrical motor, determine the power needed by the motor to maintain a constant speed (as obtained in Q6(c)) of M to climb up the slope

(10 marks)

- END OF QUESTIONS -