# NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY



### FACULTY OF INDUSTRIAL TECHNOLOGY

## DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

### **BEng Hons Industrial and Manufacturing Engineering**

**Supplementary Examination** 

COURSE : ENGINEERING DESIGN APPLICATIONS I

CODE : TIE 2107

DATE : JULY 2012

DURATION : 3 HOURS

#### INSTRUCTIONS AND INFORMATION TO CANDIDATE

- 1. Answer any four (4) questions.
- 2. Each question carries 25 marks.
- 3. This paper contains six (6) questions.
- 4. There are three(**3**) printed pages.

#### **Question 1**

A shaft is required to transmit 1 MW power at 240 r.p.m. The shaft must not twist more than 1 degree on a length of 15 diameters. If the modulus of rigidity for material of the shaft is 80GPa, find the diameter of the shaft and shear stress induced. [25]

#### **Question 2**

(i)	Define lead as applied to screws and fasteners	[1]	
(ii)	List any four (4) forms of screw threads you know	[4]	
(iii)	Derive the torque capacity of a square threaded power screw for lowering	readed power screw for lowering a load.	
	Show all steps clearly.	[20]	

### **Question 3**

A pump is driven by an electric motor through an open type flat belt drive. Determine the belt specifications (length and breadth) for the following data:

Motor pulley diameter = 300 mm, Pump pulley diameter = 600 mm; Coefficient of friction for motor pulley = 0.25; Coefficient of friction for pump pulley = 0.20; Center distance between the pulleys = 1000 mm; Rotational speed of the motor=1440 rpm; Power transmission = 20kW; Density of belt material = 1000 kg/m<sup>3</sup>; Allowable stress for the belt material = 2 MPa; Thickness of the belt = 5mm [25]

#### **Question 4**

A double threaded worm drive is required for power transmission between two shafts having their axes at right angles to each other. The worm has  $14.5^{\circ}$  full depth involute teeth. The centre distance is approximately 200 mm. If the axial pitch of the worm is 30 mm and lead angle is  $23^{\circ}$ , find:

(i)	Lead	[5]
(ii)	Pitch circle diameters of worm and worm gear	[10]
(iii)	Helix angle of the worm	[4]
(iv)	The efficiency of the drive if the coefficient of friction is 0.05	[6]

#### **Question 5**

Two cast iron bevel gears having pitch diameters 100 and 120 mm respectively are to transmit 2.75 kW at 1000 r.p.m. of the pinion. The tooth profiles are  $14.5^{\circ}$  composite form. If the endurance strength (S<sub>o</sub>) is 55 MPa, deformation factor C = 110 kN/m and the stress fatigue factor K = 1330 kN/m<sup>2</sup>,

(i)	Determine the face width and the required module from a standpoin	nt of strength	
	using the Lewis equation	[12]	
(ii)	Check the design for dynamic load and wear	[13]	

#### (ii) Check the design for dynamic load and wear

### Question 6

Describe and explain all the stages you would go through when designing your chosen machine. Your discussions should be specific to the machine of your choice. [25]

### **End of Examination**