NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF COMMERCE

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

BACHELOR OF ENGINEERING (HONS) INDUSTRIAL AND MANUFACTURING ENGINEERING

ENGINEERING DESIGN PRINCIPLES

TIE 2107

First Semester Supplementary Examination Paper

August 2015

This examination paper consists of 3 pages

Time Allowed: 3 hours

Total Marks: 100

INSTRUCTIONS

1. Answer any five (5) questions
2. Each question carries 20 marks
3. This paper contains seven (7) questions

MARK ALLOCATION

QUESTION	MARKS
1.	20
2.	20
3.	20
4.	20
5.	20
6	20
7	20
TOTAL	100

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Question 1

Derive an expression for the torque required to raise a load using a square threaded power screw.

[20]

Question 2

A solid shaft and a hollow shaft are to be of equal strength in torsion. The hollow shaft is to be 10% larger in diameter than the solid shaft and is to be made from the same material as the solid shaft. What will be the ratio of the weight of the hollow shaft to that of the solid shaft?

[20]

Question 3

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 $14\frac{1}{2}^o$ 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°, find

(a) The lead, [5]

(b) The pitch circle diameters of worm and gear, [10]

(c) Helix angle of the worm. [5]

Question 4

Two steel bevel gears, both having Brinell hardness of 250, connect two shafts at 90°. The teeth are $14\frac{1}{2}^o$ full depth and the module is 4. The number of teeth on the pinion and gear are 30 and 48 respectively; and the face width is 40 mm. determine the wear load given the information in Table Q4.

[20]

Table Q4: Bevel gear specifications

Average Brinell hardness number of steel pinion and steel gear	Surface endurance limit	Stress fatigue factor, K [kN/m^2]	
		14.5^o full depth	**20°** full depth
150	342	206	282
200	480	405	555
250	618	673	919
300	755	1004	1372
400	1030	1869	2553

Question 5

A v-belt operates on two sheaves having pitch diameters of 250 mm and 800 mm. The groove angle of the sheaves is 36° and the contact angle of the small sheave is 140°. The maximum allowable belt load is 900 N and the v-belt mass is 0.523 kg/m. The smaller sheave rotates at 1150 r.p.m, and 26 kW is to be transmitted. For a coefficient of friction of 0.2, how many belts should be used, assuming each one takes its proportional part of the load?   [20]

Question 6

For a problem of your choice, outline the stages you would undertake to fulfil the stated need.

[20]

Question 7

A bronze spur pinion (S_o = 83 MPa) rotating at 600 r.p.m drives a cast steel spur gear (S_o = 103 MPa) at a transmission ratio of 4 to 1. The pinion has 16 standard 20° full depth involute teeth of module 8. The face width of both gears is 90 mm. How much power can be transmitted from the standpoint of strength?   [20]

End of Examination Paper