UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING: METALLURGY*
SUBJECT	:	**FOUNDRY TECHNOLOGY 3**
CODE	:	**FTY302**
DATE	:	SUMMER EXAMINATION 2016 26 NOVEMBER 2016
DURATION	:	(SESSION 1) 08:30 - 11:30
WEIGHT	:	40:60
TOTAL MARKS	:	75
FULL MARKS	:	70

ASSESSOR	:	DR K. NYEMBWE/ MR E. GONYA
MODERATOR	:	MR. C.L JONES MR J DAVIES
NUMBER OF PAGES	:	6 PAGES

FILE: NO 5100

INSTRUCTIONS	:	ONLY ONE POCKET CALCULATOR PER CANDIDATE MAY BE USED.
	:	RETURN THE NOMOGRAM ON **PAGE 6** WITH YOUR NAME AND STUDENT NUMBER

All Questions are referring to the **steel casting** shown in figure 1.

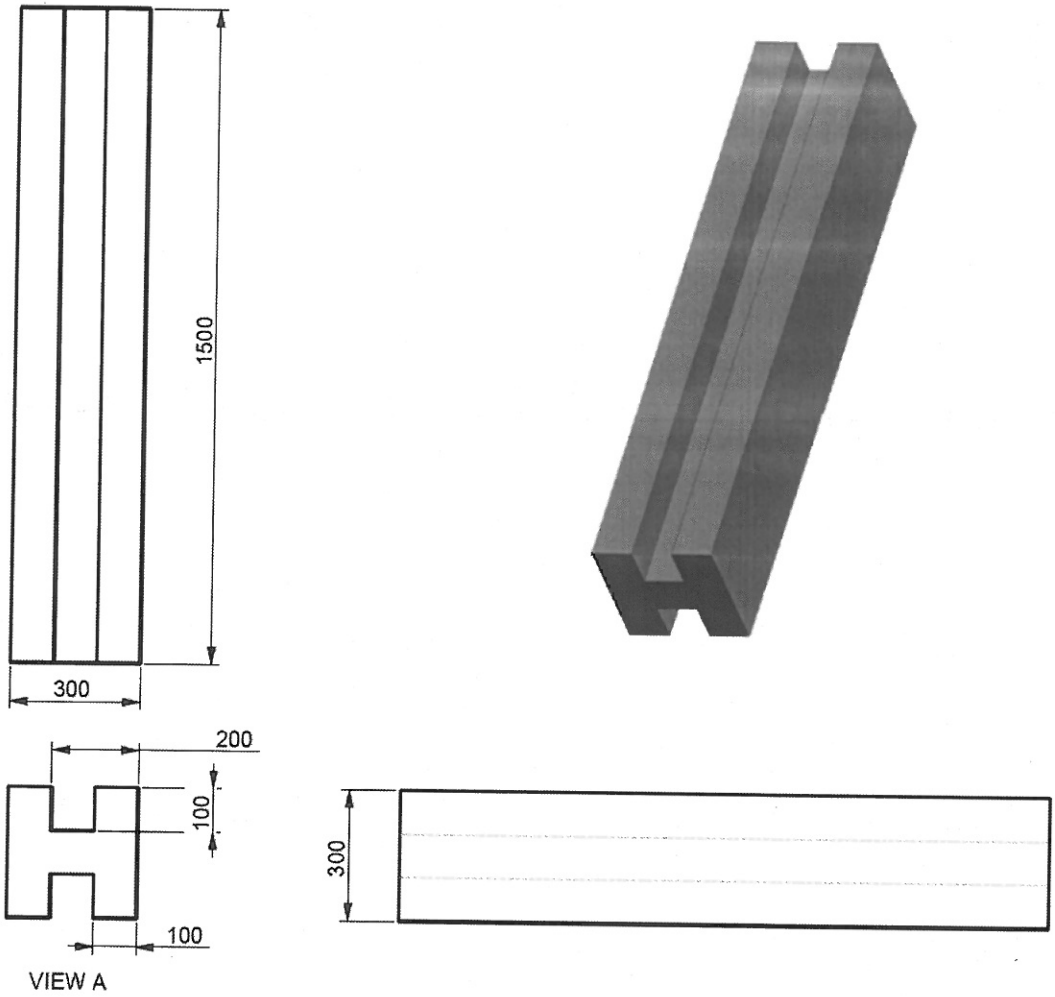

Figure 1: Two dimensional drawing of a steel bar casting
(All dimensions shown are in millimeters)

QUESTION 1

Use the information of casting methoding provided in the Table 1, the empirical equation for pouring given by equation 1 and the gating system nomogram (figure 2) in the annexure to determine the dimensions of the feeding and gating systems to produce this casting. (15)

[15]

Table 1: Casting methoding data

Alloy density	7.87 g/cm^3
Casting Volume Modulus Critical casting thickness	 105 X 10^6 mm^3 41.34 mm 100 mm
Moulding	Greensand moulding Horizontal moulding
Aided feeding system **Casting yield**	**Top/ blind** cylindrical feeder (H=D) Modulus extension: 1.5 **65% (taking into account weight of feeders and gating system)**
Gating Bottom gating Total height (h2) [mm]	 Nomogram figure 2 1300
Pouring time [sec]	Equation 1
Pouring temperature [^{0}C]	1650

Equation 1: Pouring rate of steel casting

$$R = \frac{W^P}{\left(1.34 + \frac{t}{13.77}\right)} \text{ kg/s}$$

where W = weight of casting, kg, t = critical casting thickness, mm, and P = constant (depends upon the weight of casting).

The value of constant P for different castings is as follows:

Casting weight, kg	up to 500	500-5000	5000-15000
Constant, P	0.50	0.67	0.70

QUESTION 2

2.1 Sketch the front and side two dimensional (2D) views of the **complete mounted pattern** plate with (feeding and gating systems attached) to produce the casting. The wooden plate is 2500 X 2500 x 100 mm in size. On your drawing, clearly indicate all the dimensions considering that the contraction allowance for the steel alloy is 1.6% and the machining allowance is 1 mm. (10)

2.2 On the sketch of your mounted pattern plate, show and justify areas that will require tapering and filleting according to pattern design principles. (5)

[15]

QUESTION 3

The steel casting reveals centerline shrinkage defect. As the plant metallurgist, you are asked to:

3.1 Fully explain the cause of the casting defect (2)

3.2 With the aid of the casting drawing, show and explain where this defect could possibly occur (use concept of end effect (EE) and riser effect (RE)) (3)

3.3 Fully explain the possible effects (if any) of the following changes to the feeding system in alleviating the casting defect problem:

3.3.1 Use of chills (2)

3.3.2 Increase number of feeders (2)

3.3.3 Increase of metal superheat (2)

3.3.4 Decrease of feeder volume (2)

3.3.5 Increase filling rate (2)

[15]

QUESTION 4

The casting in figure 1 has the following composition 0.14- 0.18% Carbon; 0.40- 0.60% Manganese 0.050% Max Phosphorus 0.050% Max Sulphur. The microscopic examination reveals that the casting contains regions of grossly different alloy composition.

4.1 Using the Iron carbide equilibrium diagram (known by the student) explain the cooling sequence of this alloy and the reasons behind the formation of regions with different alloy composition (5)

4.2 Briefly discuss the impact on the mechanical properties due to variation of chemical composition within the alloy and how this could be resolved? (10)

[15]

QUESTION 5

Dimensional accuracy and surface finish are two important features of this casting. Explain what type of Quality Control (QC) system needs to be put in place. In your answer, include equipment, control testing and interpretation. (15)

[15]

ANNEXURE

Name & Surname

Student Number:

Figure 2