UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING: METALLURGY*
SUBJECT	:	**FOUNDRY TECHNOLOGY 3**
CODE	:	**FTY302**
DATE	:	SUMMER SSA EXAMINATION 2017 11 JANUARY 2017
DURATION	:	(SESSION 1) 08:00 - 11:00
~~**WEIGHT**~~	:	~~40:60~~
TOTAL MARKS	:	80
FULL MARKS	:	75

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.

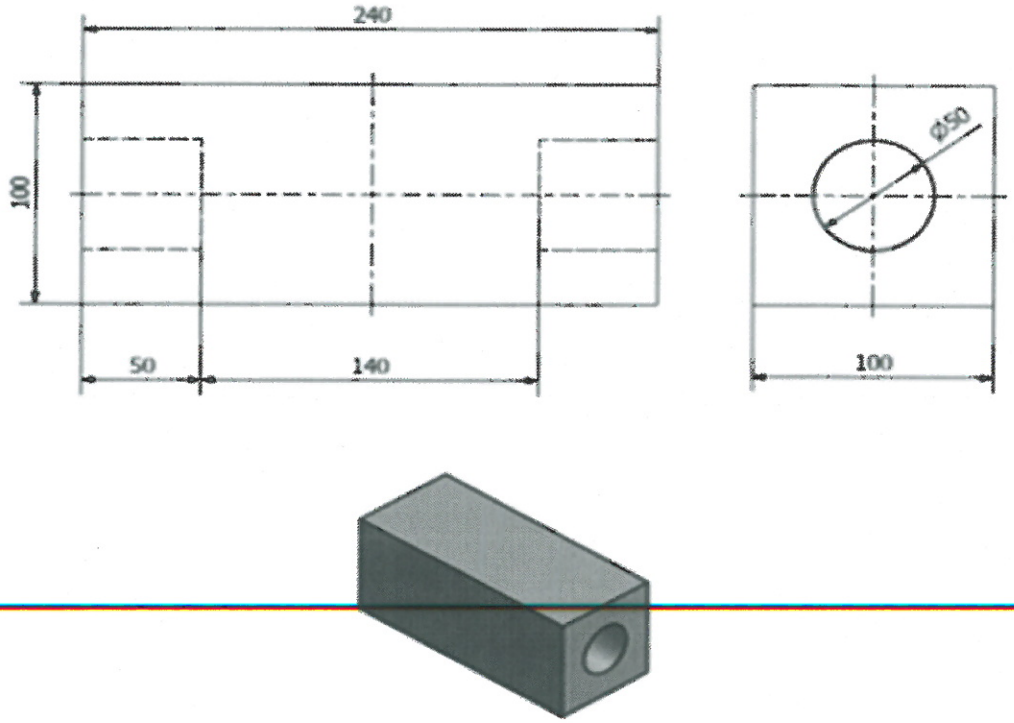

Figure 1: Two dimensional drawing of a steel bar casting
(All dimensions are in millimeter)

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 3) 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	 2203650.46mm^3 16.7mm 100mm
Moulding	Greensand moulding Horizontal moulding
Aided feeding system	**Top/ blind** cylindrical feeder (H=2D)
Casting yield	Modulus extension: 1.5 **65% (taking into account weight of feeders and gating system)**
Gating Bottom gating Total height (h2) [mm]	 Nomogram figure 3 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 500 X 500 x 20mm in size. On your drawing, clearly indicate all the dimensions considering that the thermal expansion coefficient for steel is **11.7×10^{-6} °C^{-1}** and the machining allowance is **2mm** (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 production of a new ***steel casting*** reveals that it has a particular type of defect shown in figure 2. This casting is produced in a **silica based greensand** mould. The methoding of the casting consists of an aided feeding method using **Kalmin insulated feeder sleeves** and a **pressurized side gating** system. As the plant metallurgist, you are asked to:

3.1 Identify the casting defect and provide two salient features of this type of defect (5)

3.2 Fully explain the mechanism of defect formation in the case of **silica sand** used as the refractory sand for the mould (10)

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

3.3.1 Bottom gate pouring (2)

3.3.2 Increase number of feeders (2)

3.3.3 Increase of metal superheat (2)

3.3.4 Casting filtration using ceramic filters (2)

3.3.5 Increase filling rate (2)

Figure 2. Casting defect in the steel cast component

[25]

QUESTION 4

Given that the casting in figure 1 has the following composition 0.13- 0.18% Carbon; 0.30-0.70% Manganese; 0.050% Max Phosphorus 0.050% Max Sulphur.

4.1 Using the Iron carbide equilibrium phase diagram explain how the cooling sequence of this alloy occurs and what are some of the metallurgical challenges that could be encountered during casing of this alloy (10)

4.2 Briefly explain the impact of these metallurgical challenges on the mechanical properties of the alloy and how these can they be eliminated from the casting. (5)

[15]

QUESTION 5

5.1. Explain why the surface finish is an important requirement of castings? (3)

5.2. Elaborate one technique of choice to assess the surface finish of casting. (3)

5.3. How can the technique mentioned above be an integral part of Quality Control and Assessment in the foundry? (4)

[10]

ANNEXURE

Name & Surname

Student Number:

Figure 3