Second Semester Examination
Academic Session 2018/2019

June 2019

EMH 102 – Fluids Mechanics
[Mekanik Bendalir]

Duration : 3 hours
[Masa : 3 jam]

Please check that this paper contains **EIGHT [8]** printed pages including appendix before you begin the examination.

*[Sila pastikan bahawa kertas soalan ini mengandungi **LAPAN [8]** mukasurat bercetak beserta lampiran sebelum anda memulakan peperiksaan.]*

INSTRUCTIONS : Answer **ALL FOUR [4]** questions.
*[**ARAHAN** : Jawab **SEMUA EMPAT [4]** soalan.]*

In the event of any discrepancies, the English version shall be used.

[Sekiranya terdapat sebarang percanggahan pada soalan peperiksaan, versi Bahasa Inggeris hendaklah diguna pakai.]

Thermodynamic Booklet is provided.
Buku Termodinamik adalah dibekalkan.

1. [a] Explain the vapor pressure and how it is related to cavitation phenomena?

Terangkan tekanan wap dan bagaimana ia berhubungkait dengan fenomena keronggaan.

(10 marks/*markah***)**

[b] A liquid when poured into a scaled cylinder is found to weigh 5.5N when occupying a volume of 600ml. Calculate its specific weight, density and specific gravity.

Cecair dituangkan kedalam silinder berskala didapati beratnya adalah 5.5N dengan isipadu 600ml. Kirakan berat tentu, ketumpatan dan graviti tentu bagi cecair tersebut.

(20 marks/*markah***)**

[c] A cubic iceberg has a specific gravity of 0.92 and seawater has a specific gravity of 1.025. If a 2800m^3 iceberg extends above the surface of the sea water. Calculate the volume of the iceberg below the sea surface.

Sebuah ketulan ais mempunyai graviti tentu 0.92 dan air laut mempunyai graviti tentu 1.025. Jika isipadu ketulan ais adalah 2800m^3 dilihat terkeluar diatas permukaan air laut. Kirakan isipadu ketulan ais dibawah permukaan laut.

(30 marks/*markah***)**

[d] A 5m long, 4m high U-shape container contains 2.5m deep water at static condition and is open to atmosphere, as shown in Figure 1[d]. The container is accelerated to the right on the level surface at 2m/s^2. Calculate the maximum pressure in the container relative to the atmospheric pressure.

Sebuah takungan berbentuk-U 5m panjang, 4m tinggi mengandungi air kedalaman 2.5m pada keadaan statik dan terbuka pada atmosfera seperti ditunjukkan dalam Rajah 1[d]. Takungan dipecutkan ke kanan pada permukaan sama pada 2m/s^2. Kirakan tekanan maksimum didalam takungan relatif kepada tekanan atmosfera.

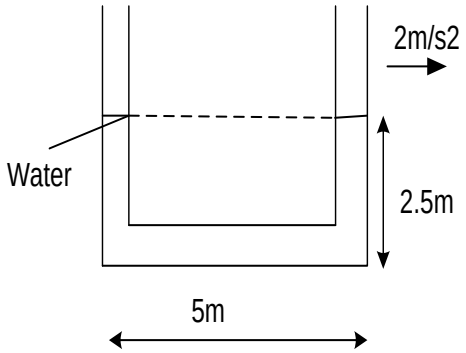

Figure 1[d]
Rajah 1[d]

(40 marks/*markah***)**

2. [a] Starting from the second law of Newton for a control volume of fluid in inviscid flow, with the aid of Figure 2[a], express a Bernoulli equation.

Bermula daripada hukum kedua Newton bagi sebuah isipadu kawalan bendalir dalam aliran tak likat, dengan bantuan dari Rajah 2[a], terbitkan persamaan Bernoulli.

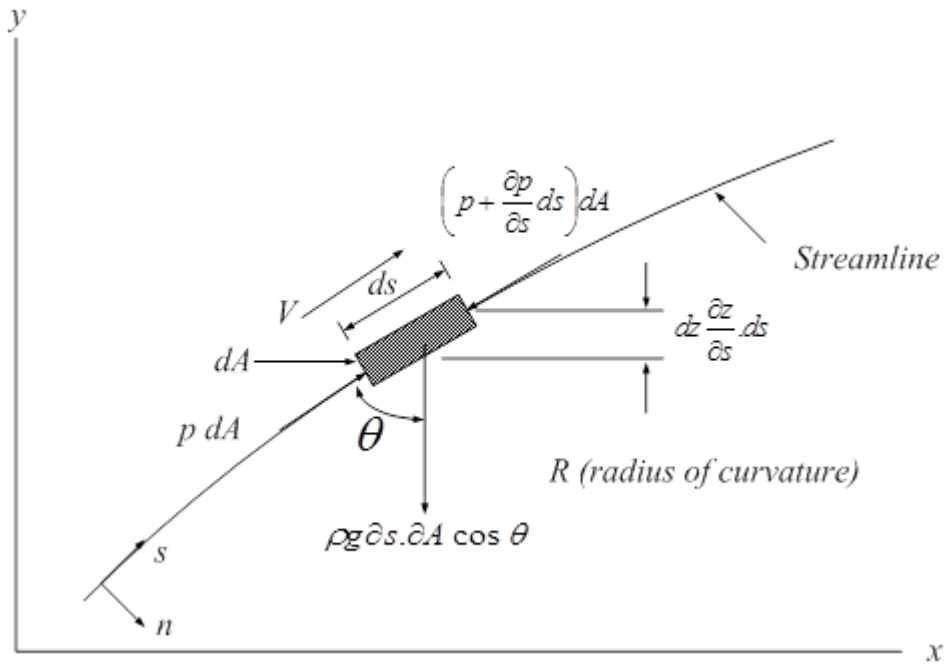

Figure 2[a]
Rajah 2[a]

(20 marks/*markah***)**

[b] **An air flow with temperature of 27˚C flow through convergent-divergent tube, as shown in Figure 2[b]. The diameter of tube in let is 1 m and diameter of throat is 0.5 m. The velocity and absolute pressure in inlet are 5 m/s and 200 kPa, respectively. The absolute pressure at throat is 100 kPa, calculate air velocity at throat. Is flow compressible or incompressible? Justify your answer. Assume flow is inviscid and constant temperature.**

Satu aliran udara pada suhu 27˚C melalui salur menumpu-mencapah, seperti yang ditunjukkan pada Rajah 2[b]. Diameter salur masukan ialah 1 m dan diameter tekak ialah 0.5 m. Halaju dan tekanan mutlak masukan ialah 5 m/s dan 200 kPa. Tekanan mutlak pada tekak ialah 100 kPa, kirakan halaju udara pada tekak. Adakah aliran mampat atau tak mampat? Wajarkan jawapan anda. Anggap aliran adalah tak likat dan suhu malar.

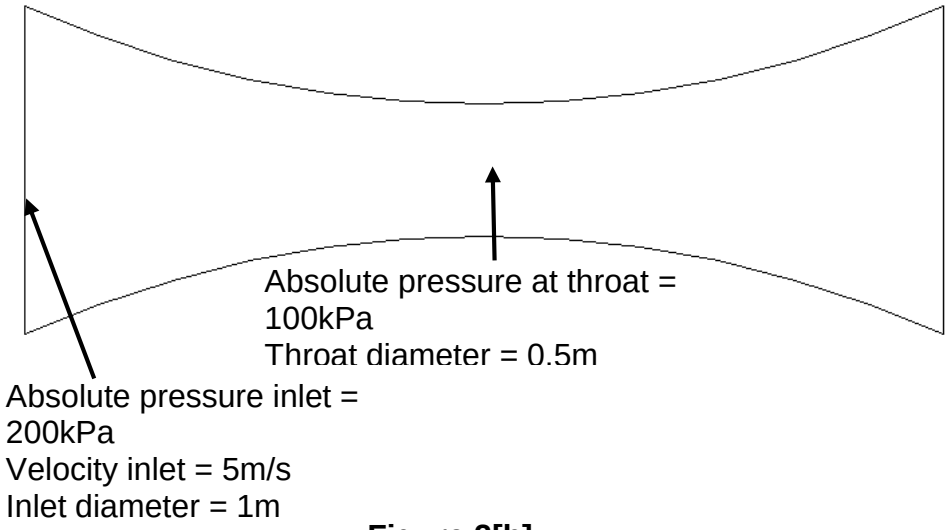

Figure 2[b]
Rajah 2[b]

(45 marks/*markah***)**

[c] **A 10 cm plate orifice at the end of a 20 cm water pipe has the deflection on the water-mercury manometer of 10 cm. Calculate the water mass flow rate. Given, kinematic viscosity = $1x10^{-6}$ m^2/s.**

Satu plat orifis 10 cm pada hujung 20 cm paip air mempunyai pesongan pada manometer air-merkuri 10 cm. Kirakan kadar aliran jisim air. Diberi, kelikatan kinematik = $1x10^{-6}$ m^2/s.

(35 marks/*markah***)**

3. [a] What is the Eulerian description of fluid motion? Give ONE difference between Eulerian and Lagrangian description?

Apakah penerangan Eulerian untuk gerakan bendalir? Berikan SATU perbezaan diantara deskripsi Eulerian dan Lagrangian.

(10 marks/*markah***)**

[b] Given the Eulerian velocity vector field as:

Diberi medan halaju vektor Eulerian sebagai:

$$\mathbf{V= 3ti + xzj + ty^2k}$$

Calculate the total acceleration of a particle.

Kirakan jumlah pecutan zarah.

(25 marks/markah**)**

[c] A flow is defined by u = 2x and v = -2y. Calculate and sketch the stream function for this flow.

Satu aliran ditentukan oleh u = 2x dan v = -2y. Kirakan dan lakarkan fungsi aliran untuk aliran ini.

(35 marks/*markah***)**

[d] SAE 10 oil flows through a cast iron pipe with a velocity of 6m/s. The pipe has a length of 55m and diameter of 160mm. Calculate head loss due to friction (use Moody diagram). Density and viscosity of SAE oil are: ρ= 869kg/m^3, μ= 0.0814Ns/m^2, respectively.

SAE 10 minyak mengalir melalui paip besi tuang dengan kelajuan 6m/s. Paip ini mempunyai panjang 55m dan diameter 160mm. Kirakan kehilangan turus akibat geseran (gunakan rajah Moody). Ketumpatan dan kelikatan minyak SAE adalah: ρ = 869kg/m^3, μ = 0.0814Ns/m^2.

(30 marks/*markah***)**

4. A prototype gate valve which will control the flow in a pipe system conveying paraffin is to be studied in a model. The pressure drop (∆P) is expected to depend upon the gate opening (h), the diameter (d), the velocity (V), density (ρ) and viscosity (μ). Given the density and viscosity of paraffin are 800 kg/m^3 and 0.002 kg/m.s. Take the kinematic viscosity and density of water as 1.0 x 10^{-6} m^2/s and 1000 kg/m^3. A 1/5 scale model is built to determine the pressure drop across the valve with water as the working fluid. Given, j = 3.

Satu prototaip injap pintu yang akan mengawal aliran dalam satu sistem paip penghantaran paraffin akan dikaji dalam satu model. Susutan tekanan (∆P) dijangkakan bergantung kepada bukaan pintu injap (h), diameter (d), halaju (V), ketumpatan (ρ) dan kelikatan (μ). Diberikan ketumpatan dan kelikatan paraffin ialah 800 kg/m^3 dan 0.002 kg/m.s. Andaikan nilai kelikatan kinematik dan ketumpatan air ialah 1.0 x 10^{-6} m^2/s dan 1000 kg/m^3. Satu ***model skala 1/5*** *dibina untuk menentukan susutan tekanan merentasi injap tersebut dimana* ***air*** *adalah* ***bendalir kerja.*** *Diberi, j = 3.*

[a] Demonstrate dimensional analysis to obtain the relevant non-dimensional groups.

Paparkan analisis dimensi untuk mendapatkan kumpulan non-dimensi yang berkaitan

(60 marks/*markah***)**

[b] Calculate the pressure drop in the prototype if it is 60 kPa in the model based on dynamic similarity.

Kirakan susutan tekanan di dalam prototaip jika nilainya 60 kPa di dalam model berdasarkan keserupaan dinamik

(40 marks/*markah***)**

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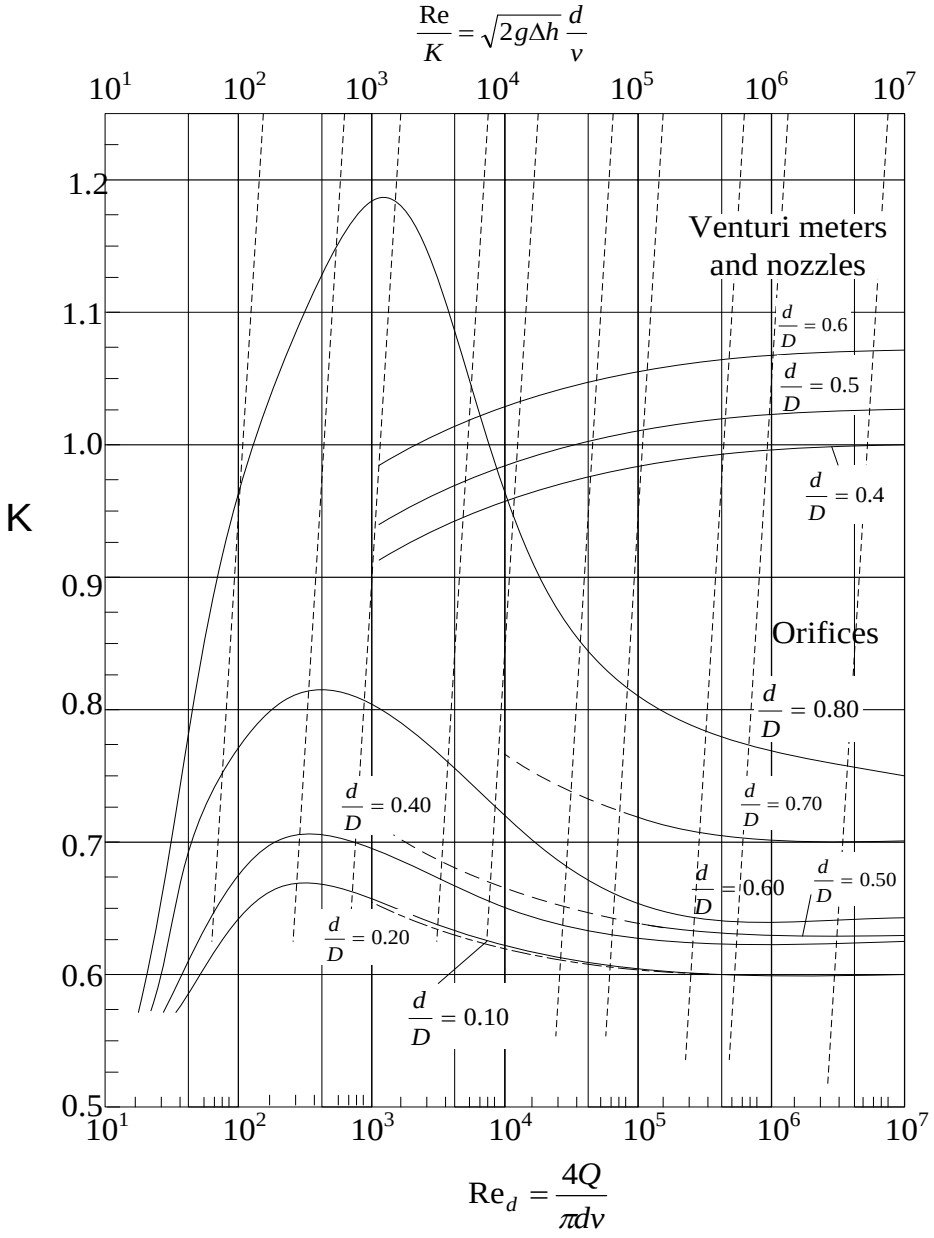
Appendix 1

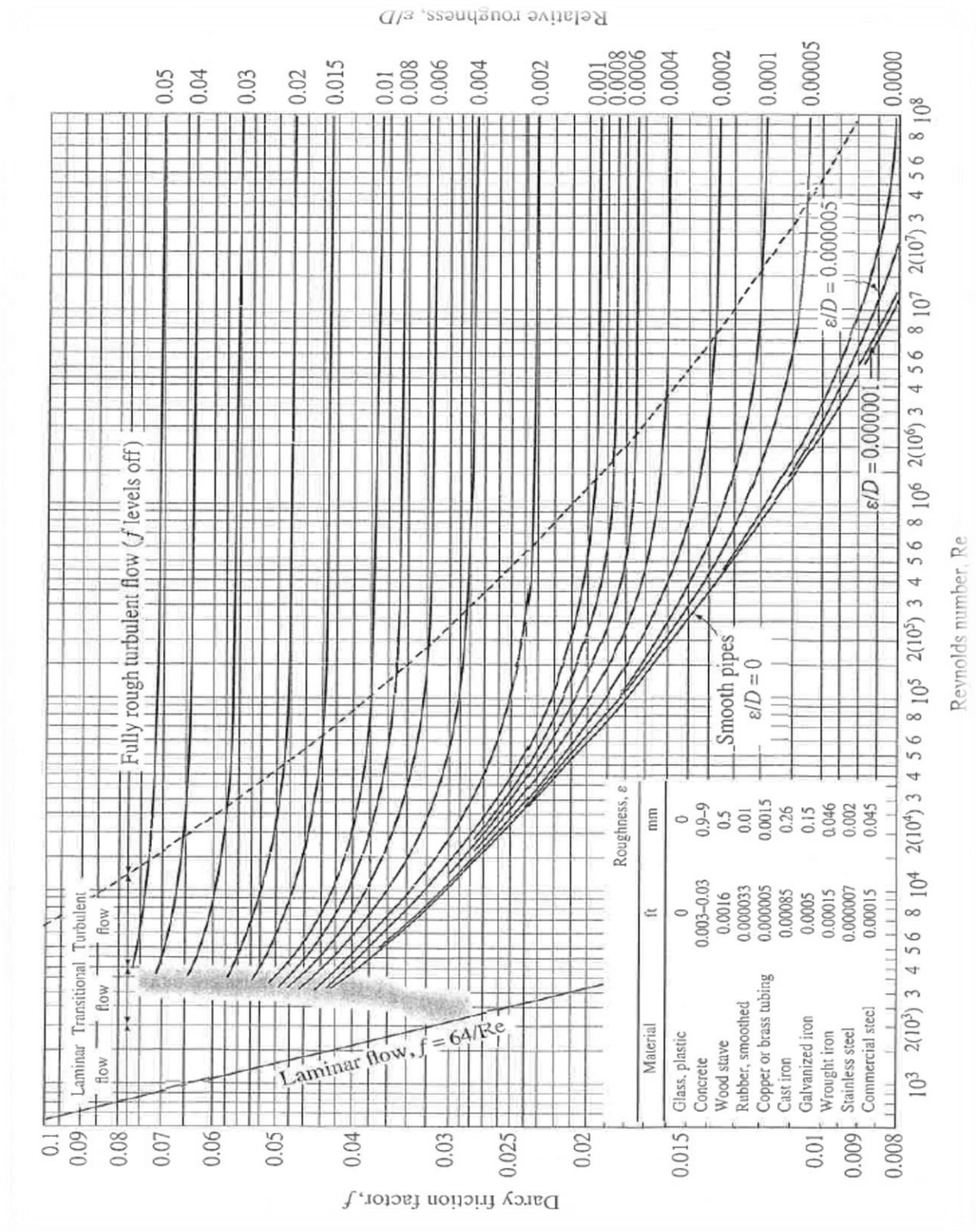
Lampiran 1



Flow coefficient chart (K)

Appendix 2

Lampiran 2



Moody Diagram