Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2019/2020

COURSE NAME	:	CIVIL ENGINEERING MATHEMATICS III
COURSE CODE	:	BFC 24103
PROGRAMME CODE	:	BFF
EXAMINATION DATE	:	JULY 2020
DURATION	:	6 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

Q1 (a) Solve $\lim_{(x,y)\to(0,0)} \frac{x^2+y^2}{\sqrt{x^2+y^2+1}-1}$.

(6 marks)

(b) Find f_x, f_y, f_{xx}, f_{xy} for function $f(x,y) = y\, tan2x$.

(8 marks)

(c) Evaluate $\int_0^1 \int_0^{\sqrt{1-x^2}} x + y \;\; dydx$ by using polar coordinates.

(6 marks)

Q2 (a) Calculate the volume of solid bounded by $y = x^2 + z^2$ and plane $y = 3$ in first octant by using triple integral.

(5 marks)

(b) A cylinder with diameter 12 cm and height 14 cm was used to collect the sample of peat soil. Determine the rate of change in a cylinder if the increasing rate of radius is 0.3 cms^{-1} and the decreasing rate of height is 0.4 cms^{-1}.

(4 marks)

(c) Given that r(t) =e^t i + 2sin$t$ j + 2cos$t$ k. Find the velocity and acceleration at $t = \pi$.

(6 marks)

(d) Find a parametric equation of the line through the points A (4,5,-3) and B (6,-5,4).

(5 marks)

Q3 (a) Solve $\int_0^1 \int_x^1 xy^3 \;\, dydx$.

(5 marks)

(b) The demand equation for a certain brand of face mask for front liners used during MCO is $k = 2xy^2z^3$ where x represents the time of face mask needed to be supplied in a month. The price of the facemask, y is given by the equation $y = x^2 + 1$ with the types of brand face mask, $z = \sqrt{x}$. Determine the quantity of the face mask needed to be supplied in a month, $\frac{dk}{dx}$ using the appropriate rule method.

(5 marks)

(c) Ukur Bina Sdn Bhd is awarded a survey work for Perwira residential apartment. As a surveyor, you are required to conduct surveying to set out the exact position of a proposed structure within the legal boundaries. The setting out works is bounded at $y = 2x$, $y = \frac{x}{2}$ and $x + y = 3$. With the aid of reference equations, sketch the bounded boundaries.

(8 marks)

(d) A particle describes a path in which its position vector, r (t), is given a function of time, t, by r(t) =3t i + 4sin$t$ j + 4cos$t$ k where i, j and k are three mutually perpendicular unit vectors. Calculate the unit tangent vector, principal unit normal vector and curvature of the particle.

(12 marks)

Q4 (a) (i) Sketch the region R enclosed between the line $y = \frac{x}{2}, y = 2x \ and \ x + y = 3.$

(4 marks)

(ii) Find the area of region R using double integrals.

(6 marks)

(b) Calculate the directional derivatives of functions $f\ (x, y) = 4x^3y^2$ at point (2,1) in the direction of vector a = 4i - 3j.

(6 marks)

(c) Find the line integral using Green's theorem $\oint_C\ y^3dx + (x^3 + 3xy^2)dy$ where C is the boundary of circle $x^2 + y^2 = 9$ which oriented counter clockwise.

(14 marks)

- END OF QUESTIONS –

FINAL EXAMINATION

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Formulae

Tangent Plane: $z - z_0 = f_x(x_o, y_0)(x - x_0) + f_y(x_o, y_0)(y - y_0)$

Polar coordinate: $x = rcos\,\theta, y = rsin\,\theta, \theta = tan^{-1}(\frac{y}{x})$ and
$\iint_R f(x,y)dA = \iint_R f(r,\theta)rdrd\theta$

Cylindrical coordinate: $x = rcos\,\theta,$, $y = rsin\,\theta,$ $z = z,$ $\iiint_G f(x,y,z)dV = \iiint_G f(r,\theta,z)d\,dz\,dr\,d\theta$

Spherical coordinate: $x = \rho\sin\phi\cos\theta,\ y = \rho\sin\phi\sin\theta,\ z = \rho\cos\theta,\ x^2 + y^2 + z^2 = \rho^2,\ 0 \ll \theta \ll 2\pi, 0 \ll \phi \ll \pi$ and $\iiint f(x,y,z)dV = \iiint f(\rho,\phi,\theta)\rho^2\sin\phi\, d\rho d\phi d\theta$

Directional derivative: $D_u f(x,y) = \left(f_x\mathbf{i} + f_y\mathbf{j}\right)\cdot u$

Let $\mathbf{F}(x,y,z) = M\mathbf{i} + N\mathbf{j} + P\mathbf{k}$ is vector field, then the divergence of $\mathbf{F} = \nabla\cdot\mathbf{F} = \frac{\partial M}{\partial x} + \frac{\partial N}{\partial y} + \frac{\partial P}{\partial z}$
The curl of

$$\mathbf{F} = \nabla\times\mathbf{F} = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ \frac{\partial}{\partial x} & \frac{\partial}{\partial y} & \frac{\partial}{\partial z} \\ M & N & P \end{vmatrix} = \left(\frac{\partial P}{\partial y} - \frac{\partial N}{\partial z}\right)\mathbf{i} - \left(\frac{\partial P}{\partial x} - \frac{\partial M}{\partial z}\right)\mathbf{j} + \left(\frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}\right)\mathbf{k}$$

Let C is a smooth curve given by $r(t) = x(t)i + y(t)j + z(t)k, t$ is parameter, then
The unit tangent vector; $\mathbf{T}(t) = \frac{\mathbf{r}'(t)}{\|\mathbf{r}'(t)\|}$
The unit normal vector: $\mathbf{N}(t) = \frac{\mathbf{T}'(t)}{\|\mathbf{T}'(t)\|}$
The binormal vector: $B(t) = T(t)\times N(t)$
The curvature: $K = \frac{\mathbf{T}'(t)}{\|\mathbf{r}'(t)\|} = \frac{\|\mathbf{r}'\times\mathbf{r}''(t)\|}{\|\mathbf{r}'(t)\|^3}$
Green Theorem: $\oint_C M(x,y)\,dx + N(x,y)\,dy = \iint_R \frac{\partial N}{\partial x} - \frac{\partial M}{\partial y}dA$