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06MAT31

Third Semester B.E. Degree Examination, December 2010
Engineering Mathematics – III

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Find the Fourier series for the function $f(x) = x(2\pi - x)$ over the interval $(0, 2\pi)$ and deduce that $\frac{\pi^2}{12} = \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n^2}$. **(07 Marks)**

b. Obtain the half-range sine series for

$$f(x) = \begin{cases} \frac{1}{4} - x, & \text{for } 0 < x < \frac{1}{2} \\ x - \frac{3}{4}, & \text{for } \frac{1}{2} < x < 1 \end{cases}$$ **(07 Marks)**

c. Obtain the constant term and the co-efficients of $\sin\theta$ and $\sin 2\theta$ in the Fourier expansion of y given the following data **(06 Marks)**

θ°	0	60	120	180	240	300	360
y	0	9.2	14.4	17.8	17.3	11.7	0

2 a. Obtain the finite Fourier sine transform of the function $f(x) = \cos kx$, where k is a non integer, over $(0, \pi)$. **(07 Marks)**

b. Find the Fourier sine and cosine transforms of $f(x) = e^{-\alpha x}$, $\alpha > 0$. **(07 Marks)**

c. Find the inverse Fourier transform of e^{-u^2}. **(06 Marks)**

3 a. Form the partial differential equation by eliminating the arbitrary functions from $Z = f(x + I t) + g(x - i t)$, where $i = \sqrt{-1}$. **(07 Marks)**

b. Solve by the method of separation of variables $p y^3 + q x^3 = 0$. **(07 Marks)**

c. Solve $(mz - ny)p + (nx - lz)q = ly - mx$. **(06 Marks)**

4 a. Derive the one – dimensional heat equation. **(07 Marks)**

b. Obtain the D'Alembert's solution of the wave equation $u_{tt} = c^2 u_{xx}$, subject to the condition $u(x, 0) = f(x)$ and $\frac{\partial u}{\partial t}(x,0) = 0$. **(07 Marks)**

c. Solve the wave equation $c^2 \frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 u}{\partial t^2}$, $0 < x < \pi$, given $u(0, t) = u(\pi, t) = 0$; $u(x, 0) = 0$; $\frac{\partial u}{\partial t}(x, 0) = A(\sin x - \sin 2x)$, $A \neq 0$. **(06 Marks)**

PART – B

5 a. Find the smallest and the largest roots of $e^x - 4x = 0$, correct to 4 decimal places by Newton – Raphson method. **(07 Marks)**

b. Solve by Gauss elimination method
$2x_1 + x_2 + 4x_3 = 12$; $4x_1 + 11x_2 - x_3 = 33$; $8x_1 - 3x_2 + 2x_3 = 20$. **(07 Marks)**

c. Find the largest eigenvalue and the corresponding eigenvector of the matrix by using power method :

$$A = \begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$$ taking $[1, 1, 1]^T$ as the initial eigenvector, perform 5 iterations. **(06 Marks)**

6 a. Using the Lagrange' formula, find the interpolating polynomial that approximates to the function described by the following table : **(07 Marks)**

X	0	1	2	3	4
f(x)	3	6	11	18	27

Hence find f(0.5) and f(3.1)

b. A rod is rotating in a plane. The following table gives the angle θ (in radians) through which the rod has turned for various values of t (in seconds)

t	0	0.2	0.4	0.6	0.8	1.0	1.2
θ	0	0.12	0.49	1.12	2.02	3.20	4.67

Calculate the angular velocity and angular acceleration of the rod at t = 0.4 second. **(07 Marks)**

c. Evaluate $\int_0^1 \frac{x}{1+x^2}dx$ by using the Simpson's $(3/8)^{th}$ rule, dividing the interval into 3 equal parts. Hence find an approximate value of $\log\sqrt{2}$. **(06 Marks)**

7 a. Derive the Euler's equation in the form $\frac{\partial f}{\partial y} - \frac{d}{dx}\left(\frac{\partial f}{\partial y'}\right) = 0$. **(07 Marks)**

b. Solve the variational problem :

$\delta\int_0^1 (x + y + y'^2)dx = 0$ under the conditions y(0) = 1 and y(1) = 2. **(07 Marks)**

c. Find the geodesics on a surface given that the arc length on the surface is

$S = \int_{x_1}^{x_2} \sqrt{x(1+y'^2)}\,dx$. **(06 Marks)**

8 a. Find the Z-transform of

i) $3n - 4\sin\frac{n\pi}{4} - 5a^2$

ii) $\cos\left(\frac{n\pi}{2} + \frac{\pi}{4}\right)$. **(07 Marks)**

b. Obtain the inverse Z-transform of $\frac{3z^2 + 2z}{(5z-1)(5z+2)}$. **(07 Marks)**

c. Solve the difference equation $u_{n+2} - 5u_{n+1} + 6u_n = 2$, with $u_0 = 3$, $u_1 = 7$ using z-transforms. **(06 Marks)**

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06ME32A

Third Semester B.E. Degree Examination, December 2010
Materials Science and Metallurgy

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Define : i) Space lattice ; ii) Unit cell ; iii) Atomic packing factor. **(06 Marks)**

b. Classify crystal imperfections. Explain the point defects, in detail. **(06 Marks)**

c. Calculate the packing efficiency of a BCC structure. **(03 Marks)**

d. Define diffusion. What are the factors affecting diffusion? **(05 Marks)**

2 a. With the help of a neat conventional stress – strain diagram, explain the behavior of mild steel, under static uniaxial, tension, till fracture. **(06 Marks)**

b. With a neat sketch, explain the plastic deformation of a single crystal, by slip. **(06 Marks)**

c. A copper wire has a nominal breaking strength of 300 MPa. Its ductility is 77% reduction of area. Calculate the true stress for fracture. **(04 Marks)**

d. Differentiate between : i) Toughness and resilience ; ii) Ductility and brittleness. **(04 Marks)**

3 a. Define creep. With a typical creep curve, explain the different stages of creep. **(06 Marks)**

b. What are the various factors affecting fatigue strength? Explain. **(06 Marks)**

c. Draw the S – N diagrams for mild steel and aluminium and explain. **(04 Marks)**

d. Write note on ductile fracture. **(04 Marks)**

4 a. Explain with neat sketches the substitutional and interstitial solid solutions, with examples. **(05 Marks)**

b. With reference to cooling curves for a binary solid solution, explain the Gibb's phase rule. **(04 Marks)**

c. What are invarient reactions? With neat sketches, explain :
i) Eutectic reaction and ii) Eutectoid reaction. **(05 Marks)**

d. Melting point of lead is 327°C and that of tin is 232°C. They form an eutectic of 62% tin at 183°C. At this temperature, the maximum solid solubility of tin in lead is 19% and that of lead in tin is 3%. Assuming liquidus and solidus lines to be straight, draw the phase diagram and label all the regions. Also find the freezing range for the 30% tin and 70% lead alloy. **(06 Marks)**

PART – B

5 a. Draw a neat sketch of iron – iron carbide equilibrium diagram and mark on it all salient temperatures, compositions and phases. Describe the mode of solidification and room temperature microstructure of a very slowly cooled steel of carbon content 1.2%. **(10 Marks)**

b. What is TTT diagram? Explain with a neat diagram the martensitic transformation of austenite. **(10 Marks)**

6 Write notes on the following heat treatment processes : a. Annealing ; b. Tempering ; c. Carburizing ; d. Precipitation hardening. **(20 Marks)**

7 a. What is meant by S.G. iron? Explain the structure, composition and properties of SG iron. **(06 Marks)**

b. Give the compositions and applications of magnesium based alloys. **(06 Marks)**

c. Write a note on aluminium alloys. **(08 Marks)**

8 a. Define corrosion in metals. Explain general methods of corrosion control and its prevention. **(10 Marks)**

b. What is electrode potential? What is its significance? **(04 Marks)**

c. With a neat sketch, explain the galvanic cell. **(06 Marks)**

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06ME32B

Third Semester B.E. Degree Examination, December 2010
Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. What do you understand by line and end standards? Explain briefly. **(06 Marks)**

b. Briefly explain the M87 and M112 set of slip gauges. **(05 Marks)**

c. Using M112 set of slip gauges, build the following dimensions:
i) 49.5555 ii) 68.208 iii) 52.498 **(09 Marks)**

2 a. Briefly explain the shaft basis and hole basis system of assigning fits to the components. **(06 Marks)**

b. What are "GO" and "NO GO" gauges? How Taylor's principle is applied in designing them. **(06 Marks)**

c. Calculate the limit of tolerance and allowance for a 25mm shaft and hole pair designated by H_8d_9, [H_8 : IT8 = 25i, d9 : IT9 = 40i , i = $0.45\sqrt[3]{D} + 0.001D$]
[Fundamental deviation = $- 16D^{0.44}$] **(08 Marks)**

3 a. What is a comparator? Explain briefly the principle of operation of mechanical comparator. **(06 Marks)**

b. Explain with a neat sketch, the electronic comparator. **(06 Marks)**

c. What is sine bar? Briefly explain the working of the sine bar, with a suitable example. **(08 Marks)**

4 a. Briefly explain the terminology of the screw threads. **(06 Marks)**

b. Derive an expression for the determination of effective diameter of a metric thread, using 3 wire method. **(08 Marks)**

c. Illustrate the principle of interferometry, with a neat sketch. **(06 Marks)**

PART – B

5 a. Briefly explain, with a block diagram, the generalized description of a measuring system. **(06 Marks)**

b. What is error? Briefly explain the different types of errors. **(06 Marks)**

c. Write short notes on the following :
i) Calibration ii) Precision iii) Accuracy iv) Hysteresis. **(08 Marks)**

6 a. Briefly explain, with a neat sketch, the cathode ray oscilloscope (CRO). **(06 Marks)**

b. With a neat sketch, explain the hydraulic dynamometer. **(06 Marks)**

c. With a neat sketch, explain the platform (scale) balance, with necessary expression. **(08 Marks)**

7 a. With a neat sketch, explain the principle of working of the McLeod gauge. **(06 Marks)**

b. What is a pyrometer? Briefly explain the working of optical pyrometer, with suitable sketches. **(07 Marks)**

c. What is a thermocouple? Briefly explain the laws of thermocouple. **(07 Marks)**

8 a. What is a rosette? Derive an expression for the gauge factor for the bonded metallic strain gauge in terms of Poisson's ratio. **(08 Marks)**

b. How do you measure the strain in the following conditions?
i) To measure axial strain only ii) To measure bending strain only. **(12 Marks)**

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06ME33

Third Semester B.E. Degree Examination, December 2010
Basic Thermodynamics

Time: 3 hrs. Max. Marks:100

Note: ***1. Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. Use of thermodynamics data handbook is permitted.

PART – A

1 a. What do you understand by microscopic and macroscopic view points? **(04 Marks)**

b. Explain mechanical, chemical and thermal equilibrium by mean s of example. **(06 Marks)**

c. With suitable examples, distinguish between :
i) Closed and open system ;
ii) Path function and point function.
iii) Intensive and extensive properties. **(06 Marks)**

d. Explain Zeroth law of thermodynamics. **(04 Marks)**

2 a. Differentiate between work and heat. **(04 Marks)**

b. What is meant by displacement work? Explain the same with reference to the quasi – static process. **(06 Marks)**

c. A balloon of flexible material is to be filled with air from a storage bottle unit. It has a volume $0.7m^3$. The atmospheric pressure is 1.013 bar. Determine the work done by the system comprising the air initially in the bottle, given that the balloon is light and requires no stretching. **(10 Marks)**

3 a. State the I^{st} law of thermodynamics. for cyclic process and show that internal energy is a property of a system. **(08 Marks)**

b. In a non–flow reversible process, the pressure and volume are related by $P = V^2 + \frac{20}{V}$, where P – is pressure in bar and V in m^3. During a process, the volume changes from $2m^3$ to $6m^3$ and heat added is 9000 kJ. Determine change in internal energy. **(06 Marks)**

c. Starting from the common state point, draw the following expansion processes on P–V diagram and write expression for the work in the case :
i) Isochoric process ; ii) Isobaric process ;
iii) Isentropic process ; iv) Isothermal process. **(06 Marks)**

4 a. Show that COP of the heat pump is greater than COP of a refrigerator by unity. **(06 Marks)**

b. A reversible heat engine is supplied 900 kJ of heat from a heat source at 500 K. The engine develops 300 kJ of net work and rejects heat to two heat sinks at 400 K and 300 K. Determine the engine thermal efficiency and magnitude of heat interaction with each of sink. **(10 Marks)**

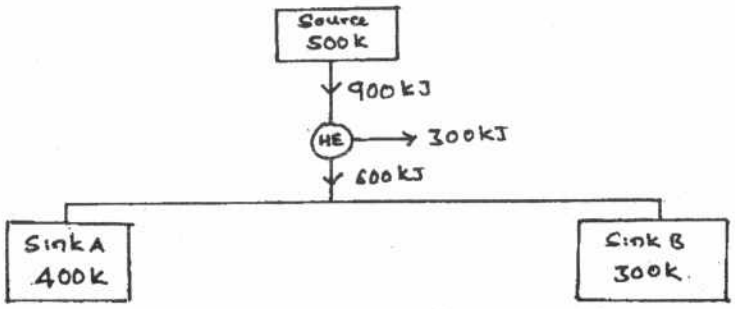

Fig.Q.4(b).

c. Give the Clausius and Kelvin – Planks statements of the second law. **(04 Marks)**

PART – B

5 a. Show that the entropy is a property of a system. **(08 Marks)**

b. 'm_1' kg of water at T_1 is isobarically and adiabatically mixed with m_2 kg of water at T_2 ($T_1 > T_2$). Show that for equal masses of water, the entropy change of the mixture is given by $(ds)_{universe} = 2mc_p \log e\left[\frac{T_1 + T_2}{2\sqrt{T_1 T_2}}\right]$ and prove that the change is necessarily positive. **(12 Marks)**

6 a. With a T-S diagram, briefly explain the available energy and unavailable energy. **(08 Marks)**

b. Derive an expression for availability analysis for steady flow open system and prove that $W_{rev} = m(\psi_1 - \psi_2)$. **(12 Marks)**

7 a. Define the following terms with reference to the pure substance.

i) Heat of fusion
ii) Latent heat of vaporization
iii) Sensible heat
iv) Saturation temperature
v) Tripple point
vi) Enthalpy
vii) Wet steam
viii) Dryness fraction. **(08 Marks)**

b. A pressure cooker contains 1.5 kg of saturated steam at 5 bar. Find quantity of heat which must be rejected so as to reduce quality to 60% dry. Determine the pressure and temperature at new state. **(12 Marks)**

8 a. Explain the Vander Walls equation of state. **(08 Marks)**

b. 5g of argon gas undergoes a change of state at constant internal energy. Initial pressure and temperature are 6 atm and 300 K respectively. The final volume occupied by the gas is 3 times that occupied initially. Assume ideal gas behaviour, determine :

i) The final temperature of the gas.
ii) The final pressure of the gas.
iii) The entropy change of the gas due to change of state. **(12 Marks)**

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06ME34

Third Semester B.E. Degree Examination, December 2010
Mechanics of Materials

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from Part – A and Part - B.***

PART – A

1 a. State Hooke's law. Sketch the typical stress – strain curve for aluminum. **(04 Marks)**

b. A stepped bar having circular sections of diameter 1.5D and D is shown in fig. Q1(b). If ρ and E are the density and Young's modulus of elasticity respectively, find the extension of the bar due to its own weight. **(08 Marks)**

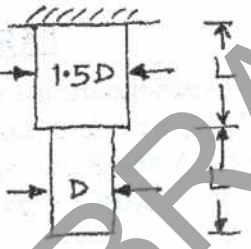


Fig. Q1(b)

c. A stepped bar of steel, held between two supports as shown in fig, Q1(c), is subjected to loads $P_1 = 80kN$ and $P_2 = 60kN$. Find the reactions developed at the ends A and B. **(08 Marks)**

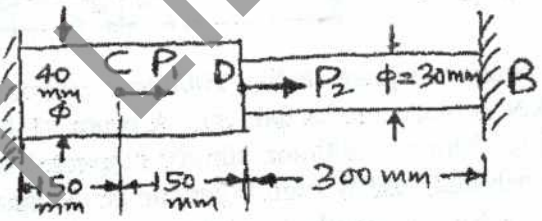


Fig. Q1(c)

2 a. Define Poisson's ratio. Using the relationship between Young's modulus of elasticity and bulk modulus, prove that the maximum value of Poisson's ratio is 0.5. **(06 Marks)**

b. AB is a rigid bar and has an hinged support at C as shown if fig. Q2(b). A steel and an aluminium bar support it at ends A and B respectively. The bars were stress free at room temperature. What are the stresses induced, when the temperature rises by 40^0C? **(14 Marks)**

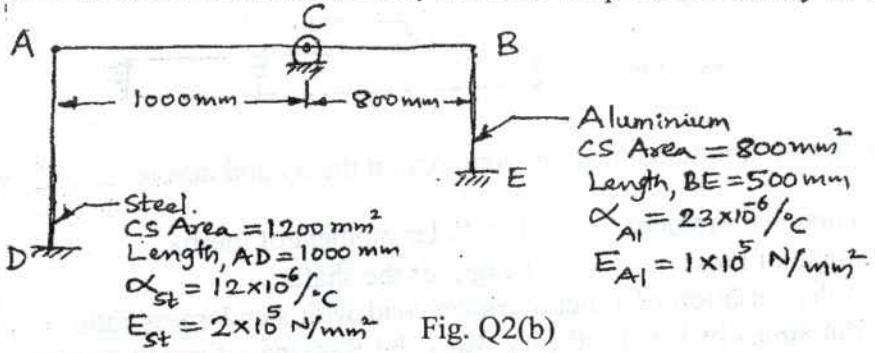
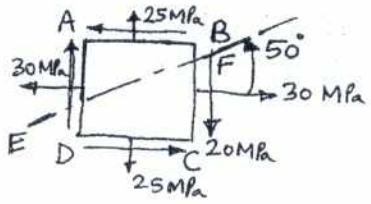


Fig. Q2(b)

3 a. Explain in brief 'plane stress'. **(04 Marks)**

b. The state of stress at a point is shown in fig. Q3(b). If the plane EF cuts the element, determine the normal and shear stresses on the plane and show them clearly on the portion of the element ABFE. **(08 Marks)**

Fig. Q3(b)



c. The state of stress at a point is expressed by principal stresses $\sigma_1 = 40$MPa and $\sigma_2 = 20$MPa. Draw Mohr's circle and determine any one plane on which the magnitude of normal stress is six times the magnitude of shear stress. **(08 Marks)**

4 a. A thin cylinder, 2m long and 200mm in diameter with 10mm thickness is filled completely with a fluid, at the atmospheric pressure. If an additional 25000mm^3 fluid is pumped in, find the longitudinal and hoop stress developed. Also determine the changes in diameter and length if $E = 2 \times 10^5$ N/mm^2 and Poisson's ratio = 0.3. **(10 Marks)**

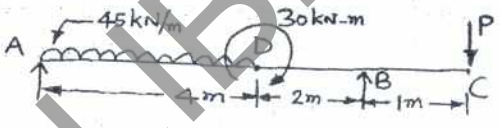
b. Derive the expressions for radial and hoop stresses (Lame's equations) for a thick cylinder. **(10 Marks)**

PART - B

5 a. Obtain the relationship between the shear force and the bending moment. **(05 Marks)**

b. For the beam shown in fig. Q5(b), determine the magnitude of the load P acting at C, such that the reaction at supports A and B are equal. Draw the shear force and bending moment diagrams, indicating the values at the salient points. Locate the point of contraflexure. **(15 Marks)**

Fig. Q5(b)

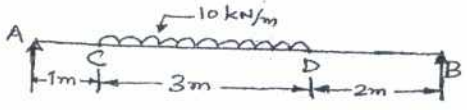


6 a. A cantilever beam of square section 200mm × 200mm, 2m long just fails in bending, when a load of 20kN is placed at its free end. A beam of the same material having a rectangular cross – section 150mm × 300mm, simply supported over a span of 3m is to be used under uniformly distributed load W n/m. What can be the maximum value of W? **(12 Marks)**

b. A cantilever beam of length 1m has a circular cross – section of diameter 300mm. Determine the concentrated load that can be applied at the free end to produce a maximum shear of 1.5N/mm^2. **(08 Marks)**

7 A beam AB shown in fig. Q7 is 6m long and has a flexural rigidity $EI = 9 \times 10^{13}$ N-mm^2. Determine i) slope at A ii) deflection at the mid span iii) maximum deflection and its location. **(20 Marks)**

Fig. Q7



8 a. State the assumptions made in pure torsion theory and derive $\frac{T}{I_p} = \frac{G\theta}{L}$, where,

T = Torsional moment ; I_p = Polar moment of inertia ; G = Modulus of rigidity ;
θ = Angle of twist ; L = Length of the shaft. **(10 Marks)**

b. Show the variation of Euler's critical load with slenderness ratio. Using the same, explain the limitations of Euler's theory. How the Rankine's formula overcomes these limitations? **(10 Marks)**

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06ME35

Third Semester B.E. Degree Examination, December 2010
Manufacturing Processes - I

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from Part – A and Part – B.***

PART – A

1 a. Briefly discuss the steps involved in making a casting. **(06 Marks)**
b. Discuss the different materials used in making a pattern. **(06 Marks)**
c. What is the need for pattern allowances? Explain each one of them, briefly. **(08 Marks)**

2 a. What are cores? Briefly explain their significance, in the sand moulding process. **(05 Marks)**
b. Explain with a sketch, the working of a jolt type moulding machine. **(07 Marks)**
c. With the help of a neat sketch, explain any two different types of gating systems. **(08 Marks)**

3 a. Explain with a sketch, the shell moulding process. **(10 Marks)**
b. Explain i) centrifugal casting process ii) continuous casting process. **(10 Marks)**

4 a. Describe with a neat sketch, the coreless induction furnace. **(08 Marks)**
b. Sketch and explain the working of a cupola, with different zones within the coke bed. **(12 Marks)**

PART – B

5 a. Describe the principles of arc welding process. **(06 Marks)**
b. Explain the following, with a neat sketch :
i) Atomic hydrogen welding ii) Submerged arc welding. **(14 Marks)**

6 a. Explain the principle of resistance welding. Also list the major applications of the process. **(06 Marks)**
b. With a sketch, explain the process of laser welding. Mention its advantages and limitations. **(08 Marks)**
c. Describe the principles of seam welding. **(06 Marks)**

7 a. Explain the various regions of HAZ in low carbon steel, during welding. **(08 Marks)**
b. Write a note on shrinkage and residual stresses in welds. **(06 Marks)**
c. Explain the different welding defects, their causes and remedies. **(06 Marks)**

8 a. Explain the following types of non destructive methods of inspection, with necessary sketches : i) Magnetic particle inspection ii) Ultrasonic inspection. **(14 Marks)**
b. Describe the brazing process. List its advantages and limitations. **(06 Marks)**

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06ME36A/46A

Third/Fourth Semester B.E. Degree Examination, December 2010
(ME/IP/AU/IM/MA/AE/MI)
COMPUTER AIDED MACHINE DRAWING

Time: 3 hrs. **Max. Marks: 100**

Note: 1. Answer any **ONE** question from each of the parts **A**, **B** and **C**.
2. Use **FIRST ANGLE** projection only.
3. Missing data if any may suitably be assumed.
4. All the calculations should be on answer sheet supplied.
5. All the dimensions are in mm.
6. Drawing instruments may or may not be used for sketching
7. **Part C Assembled View should be in 3D and other 2 views in 2D.**

PART – A

1. A cylinder of base diameter 50mm and axis 100mm long rests on its base on the HP. A VT cuts the cylinder at 70^0 to the HP through the mid point of the axis. Draw the front view, sectional plan and true shape of section. **(20 marks)**

2. Draw two views of hexagonal headed bolt with nut for a 30mm diameter bolt. Take length of bolt equal to 125mm. **(20 marks)**

PART – B

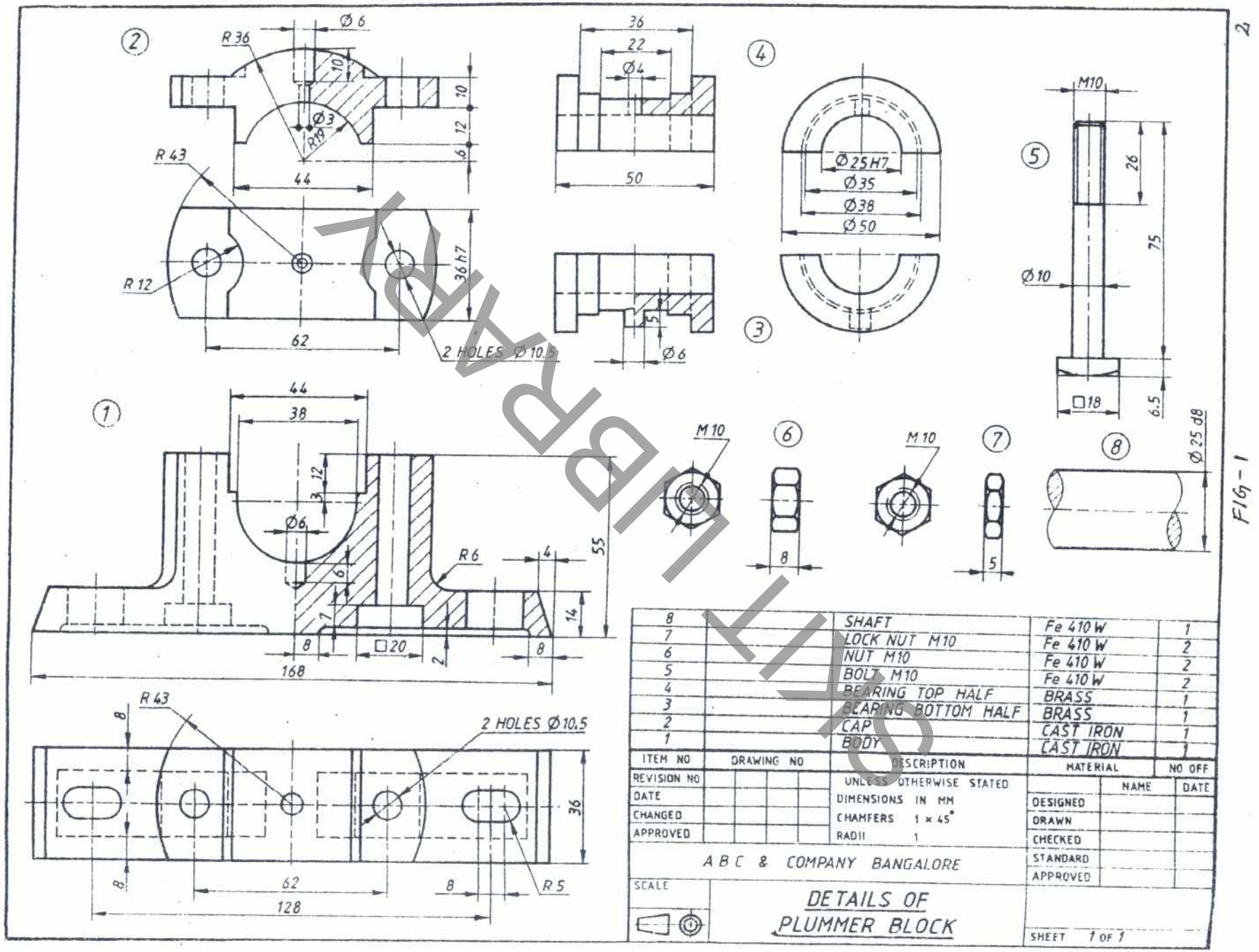
3. Draw a knuckle joint to connect two rods of 25mm diameter showing sectional front view and top view. Indicate all the proportions with dimensions. **(20 marks)**

4. Draw bushed-pin type of flexible coupling to connect two shafts of 20mm diameter for the following views:
   (i) Front View with top half in section.
   (ii) Side View from pin-head end **(20 marks)**

PART – C

5. Details of a " PLUMMER BLOCK" are shown in figure 1. Assemble the parts and draw the following views of the assembly:
   a. Front View showing right half in section.
   b. Top View. **(60 marks)**

6. Figure 2. shows the details of a Machine Vice. Assemble the parts and draw
   c. Sectional Front View.
   d. Top View. **(60 marks)**



ITEM NO	DRAWING NO	DESCRIPTION	MATERIAL	NO OFF
8		SHAFT	Fe 410 W	1
7		LOCK NUT M10	Fe 410 W	2
6		NUT M10	Fe 410 W	2
5		BOLT M10	Fe 410 W	2
4		BEARING TOP HALF	BRASS	1
3		BEARING BOTTOM HALF	BRASS	1
2		CAP	CAST IRON	1
1		BODY	CAST IRON	1

REVISION NO		UNLESS OTHERWISE STATED	
DATE		DIMENSIONS IN MM	
CHANGED		CHAMFERS 1 × 45°	
APPROVED		RADII 1	

	NAME	DATE
DESIGNED		
DRAWN		
CHECKED		
STANDARD		
APPROVED		

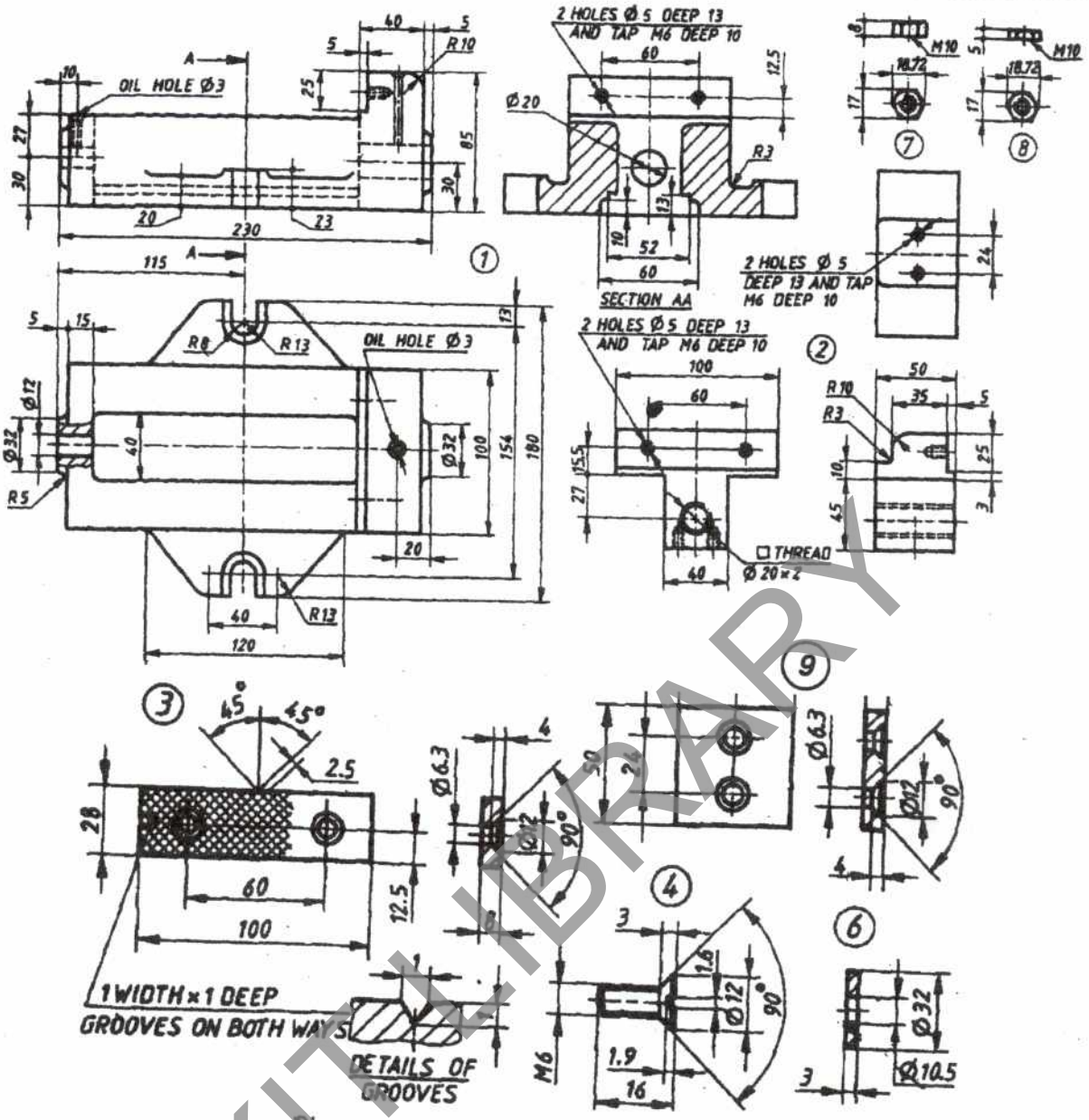
ABC & COMPANY BANGALORE

SCALE

DETAILS OF PLUMMER BLOCK

SHEET 1 OF 1

FIG - 1



PART No.	DESCRIPTION	MATERIAL	No. OFF
9	CLAMPING PLATE	Fe 410W	1
8	LOCK NUT	Fe 410W	1
7	NUT	Fe 410W	1
6	WASHER	Fe 410W	4
5	SCREW ROD	Fe 410W	1
4	SCREW M 6	Fe 410W	6
3	JAW GRIP	CAST STEEL	2
2	MOVABLE JAW	CAST IRON	1
1	BODY	CAST IRON	1

FIG – 2 Detail Parts View of Machine Vice

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06ME36B

Third Semester B.E. Degree Examination, December 2010
Fluid Mechanics

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any FIVE full questions, selecting at least TWO questions from each part.***
2. Missing data, if any, may be suitably assumed.

PART – A

1 a. Define and explain the following :
i) Viscosity ii) Surface tension iii) Bulk modulus iv) Capillarity v) Cavitation. **(10 Marks)**

b. A square metal plate of side 2m and 2mm thick, weighing 80 N is to be lifted through the middle of a vertical gap of 30mm of infinite extent. The oil in the gap has specific gravity 0.9 and viscosity 30 poise. If the metal plate is to be lifted at the constant speed of 0.15 m/s, find the force and power required. Consider the effect of buoyancy and weight of the plate. **(10 Marks)**

2 a. Derive the expressions for hydrostatic force and depth of centre of pressure for an inclined submerged plane surface. **(10 Marks)**

b. A manometer using mercury as manometric fluid is connected to two pipes A and B. Water flows through pipe A and a liquid of specific gravity 0.9 flows through pipe B. Pipe B is 1.5m above the level of pipe A. Meniscus of mercury in the left limb connected to A is 3m below A and the meniscus on the right limb connected to pipe B is 10cm above that in the left limb. If the pressure in pipe A is 10 bar, determine the pressure in pipe B. **(05 Marks)**

c. A solid cylinder 2m in diameter and 3m height is floating in water with its axis vertical. If the specific gravity of the cylinder is 0.7, find its metacentric height. State whether the equilibrium is stable or not. **(05 Marks)**

3 a. Differentiate between:
i) Steady and unsteady flow
ii) Laminar and turbulent flow.
iii) Compressible and incompressible flow.
iv) Rotational and irrotational flow.
v) Local acceleration and convective acceleration. **(10 Marks)**

b. The velocity vector in a fluid flow is given by $V = (xy + 2zt)i + (2y^2 + xyt)j + (12xy)k$, where x, y and z are in meters and t in seconds. Determine the acceleration components in x, y and z directions and resultant acceleration of the fluid particle at (2, 1, 3) at t = 1 sec. **(10 Marks)**

4 a. Using the Buckingham's π theorem, show that the discharge Q consumed by an oil ring is given by $Q = Nd^3\left[\frac{\mu}{\rho Nd^2}, \frac{\sigma}{\rho N^2 d^3}, \frac{w}{\rho N^2 d}\right]$, where d is the internal diameter of the ring, N is rotational speed, ρ is density, μ is viscosity , σ is surface tension and w is specific weight of oil. **(10 Marks)**

b. Explain the three types of similarities. **(06 Marks)**

c. Define and explain : i) Reynolds number ii) Euler's number. **(04 Marks)**

PART – B

5 a. Derive the Euler's equation of motion for steady flow. Obtain the Bernoulli's equation from it. State the assumptions made. **(08 Marks)**

b. A pump has tapering pipe running full of water. The pipe is placed vertically with the diameter at the base and top being 1.5m and 0.75m respectively. The pressure at the upper end is 250mm of mercury (vacuum), while the pressure at the lower end is 18 kN/m^2. Assume head loss to be 25% of the difference in the velocity head. Calculate the discharge. The flow is vertically upwards. The difference of elevations is 4 m. **(08 Marks)**

c. State the impulse momentum principle. Explain how it is used in determining the force exerted by a flowing fluid in a pipe bend. **(04 Marks)**

6 a. Derive the Darcy-Weisbach equation to calculate loss of head due to friction in pipes. **(08 Marks)**

b. Explain the working principle of pitot tube. **(04 Marks)**

c. A venturimeter with the throat diameter 10 cm and area ratio 4 is provided in a vertical pipeline carrying oil of specific gravity 0.9. The difference in elevation of throat section and entrance section of the venturimeter is 30 cm. The differential U tube mercury manometer shows a gauge deflection of 25 cm. Calculate i) Discharge of the oil ii) The pressure difference between entrance section and throat section. Take $C_d = 0.98$. **(08 Marks)**

7 a. Derive the expression for shear stress distribution for laminar flow between two parallel fixed plates. **(10 Marks)**

b. Oil having viscosity of 0.96 poise and the specific gravity of 0.97 is pumped through a horizontal pipe of 5 cm diameter. If the pressure drop per meter length of the pipe is 6 kPa, determine

i) the rate of flow in kilograms per minute
ii) the shear stress at the pipe wall
iii) the total drag for 100m length of pipe
iv) the power required for 100m length of the pipe to maintain the flow. **(10 Marks)**

8 a. If the velocity profile in a laminar boundary layer is approximated by a parabolic profile. $\frac{u}{U} = 2\left(\frac{y}{\delta}\right) - \left(\frac{y}{\delta}\right)^2$, where u is the velocity at y and $u \to U$ as $y \to \delta$. Calculate the displacement thickness and the momentum thickness. **(06 Marks)**

b. Derive an expression for the velocity of propagation of elastic wave in an adiabatic medium. **(10 Marks)**

c. An observer on the ground hears the sonic boom of a plane 15 km above, when the plane has gone 20 km ahead of him. Estimate the speed of the flight of plane. Take pressure = 0.8 bar and temperature = 7°C. **(04 Marks)**

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MATDIP301

Third Semester B.E. Degree Examination, December 2010
Advanced Mathematics – I

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Find the n^{th} derivative of $\log(ax + b)$. **(06 Marks)**

b. Find the n^{th} derivative of $\frac{x}{(1+3x+2x^2)}$. **(07 Marks)**

c. If $x = \sin t$ and $y = \cos mt$, prove that $(1 - x^2)\, y_{n+2} - (2n + 1)\, xy_{n+1} + (m^2 - n^2)\, y_n = 0$. **(07 Marks)**

2 a. Show that the following pair of curves intersect each other orthogonally: $r = a(1 + \sin\theta)$ and $r = a(1 - \sin\theta)$. **(06 Marks)**

b. Find the pedal equation of the curve $\frac{2a}{r} = 1 + \cos\theta$. **(07 Marks)**

c. Find the first five terms of the Maclaurin series of $f(x) = \log \sec x$. **(07 Marks)**

3 a. If $u = e^{ax - by} \sin(ax + by)$, show that $b\frac{\partial u}{\partial x} - \frac{\partial u}{\partial y} = 2abu$. **(06 Marks)**

b. If $u = \sqrt{x^2 + y^2}$ and $x^3 + y^3 + 3axy = 5a^2$, find $\frac{du}{dx}$ when $x = y = a$. **(07 Marks)**

c. If $z = f(x, y)$, where $x = r\cos\theta$ and $y = r\sin\theta$, show that, $\left(\frac{\partial z}{\partial x}\right)^2 + \left(\frac{\partial z}{\partial y}\right)^2 = \left(\frac{\partial z}{\partial r}\right)^2 + \frac{1}{r^2}\left(\frac{\partial z}{\partial \theta}\right)^2$ **(07 Marks)**

4 a. Obtain the reduction formula for $\int \cos^n x\, dx$, where n is a positive integer. **(06 Marks)**

b. Show that $\int_0^{\pi} \frac{\sqrt{1-\cos\theta}}{1+\cos\theta} \sin^2\theta\, d\theta = \frac{8\sqrt{2}}{3}$. **(07 Marks)**

c. Evaluate $\int_0^a \int_0^{\sqrt{a^2 - x^2}} x^2 y\, dy\, dx$. **(07 Marks)**

5 a. Prove that $\left|\frac{1}{2} = \sqrt{\pi}\right.$. **(06 Marks)**

b. Show that $\int_0^{\pi/2} \sqrt{\sin\theta}\, d\theta \times \int_0^{\pi/2} \frac{d\theta}{\sqrt{\sin\theta}} = \pi$. **(07 Marks)**

c. Prove that $\beta(m, n) = \frac{\lfloor m \rfloor \lfloor n}{\lfloor m+n}$. **(07 Marks)**

6 a. Solve $(e^4 + 1)\cos x\, dx + e^4 \sin x\, dy = 0$. **(06 Marks)**

b. Solve $\left(x\tan {}^{y}/_{x} - y\sec^2 {}^{y}/_{x}\right)ds + x\sec^2\left({}^{y}/_{x}\right)dy = 0$. **(07 Marks)**

c. Solve $(x + \tan y)\, dy = \sin 2y\, dx$. **(07 Marks)**

7 a. Solve $\frac{d^2y}{dx^2}+3\frac{dy}{dx}+2y=e^{-2x}$. **(06 Marks)**

b. Solve $\frac{d^2y}{dx^2}+2\frac{dy}{dx}-5y=\cos 3x$. **(07 Marks)**

c. Solve $(D^2 - 5D + 1)y = 1 + x^2$. **(07 Marks)**

8 a. Prove that $(1 + \cos\theta + i \sin\theta)^n + (1+ \cos\theta - i \sin\theta)^n = 2^{n+1} \cos^n\left(\frac{\theta}{2}\right)\cos\left(\frac{n\theta}{2}\right)$. **(06 Marks)**

b. Use Demoivre's theorem and solve the equation $x^4 - x^3 + x^2 + 1 = 0$. **(07 Marks)**

c. Expand $\cos^8\theta$ in a series of cosine of multiples of θ. **(07 Marks)**

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