USN | | | | | | | | | | |

06MAT41

# Fourth Semester B.E. Degree Examination, December 2012
# Engineering Mathematics – IV

Time: 3 hrs. Max. Marks:100

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



## PART – A

1 a. Given that $\frac{dy}{dx} = x^2 + y^2$ and $y(0) = 1$, to find an approximate value of y at x = 0.1 and x = 0.2 by Taylor's series method. **(06 Marks)**

b. Using Euler's modified method, solve for y at x = 0.1 if $\frac{dy}{dx} = \frac{y-x}{y+x}$, y(0) = 1, carryout three modifications. **(07 Marks)**

c. Given $\frac{dy}{dx} = (1+y)x^2$ and y(1) = 1, y(1.1) = 1.233, y(1.2) = 1.548, y(1.3) = 1.979, determine y(1.4) by Adams – Bash forth method. **(07 Marks)**

2 a. Show that an analytic function with constant modulus is constant. **(06 Marks)**

b. Find the analytic function $f(2) = u + iv$, if $u = e^{-x}\{(x^2 - y^2)\cos y + 2xy \sin y\}$ **(07 Marks)**

c. Find the bilinear transformation which maps the points z = 1, i, -1 into the points w = i, 0, -i and hence find the image $|z| < 1$. **(07 Marks)**

3 a. Using the Cauchy's integral formula, to evaluate $\int_C \frac{\cos \pi z^2}{(z-1)(z-2)} dz$ where c : $|z| = 3$. **(06 Marks)**

b. Obtain the Laurent's series for the function $f(z) = \frac{z^2 - 1}{z^2 + 5z + 6}$ in the regions i) $2 < |z| < 3$ ii) $|z| > 3$. **(07 Marks)**

c. Determine the poles of $\frac{z^2}{(z-1)^2(z+2)}$ and the residues at each pole. **(07 Marks)**

4 a. Prove that $e^{\frac{x}{2}(t-\frac{1}{t})} = \sum_{n=-\infty}^{\infty} t^n J_n(x)$. **(06 Marks)**

b. Show that $J_n(x) = \frac{x}{2n}\{J_{n+1}(x) + J_{n-1}(x)\}$ **(07 Marks)**

c. Explain the polynomial $2x^3 - x^2 - 3x + 2$ in terms of Legendre's polynomials. **(07 Marks)**

## PART – B

5 a. Fit a straight line to the following data: **(06 Marks)**

| x: | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| y: | 1.0 | 1.8 | 3.3 | 4.5 | 6.3 |

5 b. Prove that $\tan\theta = \left(\frac{1-r^2}{r}\right)\frac{\sigma_x\sigma_y}{\sigma_x^2+\sigma_y^2}$, where $\gamma$, $\sigma_x$, $\sigma_y$ have their usual meanings and explain the significance of $r = \pm 1$ and $r = 0$. **(07 Marks)**

c. A certain problem is given to four students for solving. The probability of their solving the problem are ½, ⅓, ¼ and ⅕ respectively. Find the probability that the problem is solved. **(07 Marks)**

6 a. The probability density function P(x) of a continuous random variables is given by, $P(x) = y_0 e^{-|x|}$, $-\infty < x < \infty$, prove that $y_0 = ½$. Find the mean and variance of the distribution. **(06 Marks)**

b. Derive the mean and variance of the binomial distribution. **(07 Marks)**

c. If x is an exponential variate with mean 4, evaluate i) P(0<x<1) ii) P(x>2) and iii) P(-∞<x<10). **(07 Marks)**

7 a. Define the terms: i) Null hypothesis ii) Level of significance and iii) Confidence limits. **(06 Marks)**

b. A sugar factory is expected to sell sugar in 100 kg bags. A sample of 144 bags taken from a day's output shows the average and S.D. of weights of these bags as 99 and 4 kg respectively. Can we conclude that the factory is working as per standards? (Table value of z = 1.96 at 5% Log) **(07 Marks)**

c. The following table gives the number of aircraft accidents that occurred during the various days of the week. Find whether the accident are uniformly distributed over the week. ($X^2_{0.05} = 9.41$ for 4 d.f.) **(07 Marks)**

| Day | Sun | Mon | Tue | Wed | Thu | Fri | Sat | Total |
|---|---|---|---|---|---|---|---|---|
| No. of accident | 14 | 16 | 8 | 12 | 11 | 9 | 14 | 84 |

8 a. The joint probability distribution for the following table:

| x \ y | 2 | 3 | 4 |
|---|---|---|---|
| 1 | 0.06 | 0.15 | 0.09 |
| 2 | 0.14 | 0.35 | 0.21 |

Determine the marginal distribution of x and y and verify that x and y are independent variables. **(06 Marks)**

b. Find the fixed probability vector of the following regular stochastic matrix.

$$A = \begin{bmatrix} ½ & ¼ & ¼ \\ ½ & 0 & ½ \\ 0 & 1 & 0 \end{bmatrix}.$$ **(07 Marks)**

c. Define the following terms:
i) Regular state ii) Periodic state iii) Recurrent state and iv) Transient state. **(07 Marks)**

* * * * *

USN | | | | | | | | | | |

06ME42B

# Fourth Semester B.E. Degree Examination, December 2012
## Mechanical Measurements and Metrology

Time: 3 hrs. Max. Marks:100

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



### PART – A

1 a. Define metrology. Differentiate between line standard and end standard, with examples. **(08 Marks)**

b. Four length bars A, B, C and D, each having a basic length of 250 mm are to be calibrated using a calibrated length bar of 1000 mm basic length. The 1000 mm bar has an actual length of 999.9991 mm. Bar 'B' and bar 'C' are longer than bar 'A' by 0.0001 mm and 0.0005mm respectively. But bar 'D' is shorter than bar 'A' by 0.0002 mm. It is also seen that $L_A + L_B + L_C + L_D = L + 0.0003$ mm. Determine the lengths of bars A, B, C and D. **(08 Marks)**

c. Give the details of M112 slip gauges and build the dimension 137.7395 mm. **(04 Marks)**

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

b. Determine the actual dimensions to be provided for a shaft and hole of 70 mm size for $H_8d_9$ fit type. Size 70 mm lies in diameter steps of 50-80 mm. Value of tolerance unit $i = 0.45\sqrt[3]{D} + 0.001D$ microns. Value of tolerance for IT8 and IT9 grades are 25i and 40i respectively. Value of fundamental deviation for 'd' shaft is given by $-16D^{0.44}$ microns. Represent schematically. **(08 Marks)**

c. With neat sketches, explain the types of fit. **(06 Marks)**

3 a. What is a comparator? Briefly explain with a neat sketch, the principle of operation of sigma comparator. **(08 Marks)**

b. With a neat sketch, explain the back pressure type of pneumatic comparators. **(06 Marks)**

c. Write a note on angle gauges and build the angle 35° 32′ 36″. **(06 Marks)**

4 a. Explain with neat sketches, how you would measure i) Minor diameter of an internal thread and ii) Major diameter of an external thread. **(08 Marks)**

b. Define "effective" diameter. Derive an expression for measuring the "effective" diameter of a metric thread by using the "2-wire" method. **(08 Marks)**

c. Write a note on optical flats. **(04 Marks)**

## PART – B

5 a. What do you understand by the term "measurement"?
Define the terms: i) Accuracy ii) Calibration iii) Loading effect iv) System response. **(06 Marks)**

b. What is a "transducer"? With the help of neat sketches explain the various types of pressure sensitive elements used as mechanical transducers. **(08 Marks)**

c. What is 'error'? Explain the classification of errors. **(06 Marks)**

6 a. Enumerate the importance of intermediate modifying devices. Explain the inherent problems in a mechanical system. **(08 Marks)**

b. Explain the ballast circuit and indicate its input-output relationship. **(06 Marks)**

c. With a neat sketch, explain the working principle of a CRO. **(06 Marks)**

7 a. Derive an expression for measuring "sensitivity" of an analytical balance. **(08 Marks)**

b. Sketch and explain the working of a hydraulic dynamometer. **(06 Marks)**

c. Describe with a neat sketch the McLeod vacuum gauge. **(06 Marks)**

8 a. With a neat sketch, discuss the construction and working of an optical pyrometer. **(08 Marks)**

b. Explain the laws of thermocouple. **(06 Marks)**

c. What is a strain gauge? Differentiate between wire type and foil type strain gauges, with neat sketches. **(06 Marks)**

* * * * *

USN | | | | | | | | | | |

06ME44

# Fourth Semester B.E. Degree Examination, December 2012
## Kinematics of Machines

Time: 3 hrs. Max. Marks:100

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



### PART – A

1 a. Define the following :
i) Machine ii) Mechanism iii) Inversion iv) Mobility of mechanism. **(08 Marks)**

b. Describe with neat sketches of the following:
i) The crank slotted lever mechanism ii) Scotch yoke mechanism. **(12 Marks)**

2 a. Explain the Peaucellier's straight line mechanism with neat sketch. **(10 Marks)**

b. Sketch and explain:
i) Any one intermittent mechanism ii) Pantograph. **(10 Marks)**

3 A four bar mechanism ABCD is made up of four links, pin jointed at the ends. AD is fixed link of 180 mm long, links AB, BC and CD are 90 mm, 120 mm and 120 mm long respectively. At certain instant, the AB rotates at an angle of 60° with link AD. If link AB rotates at a uniform speed of 100 rpm, clockwise, determine:
i) Angular velocity of links BC & CD ii) Angular acceleration of link BC & CD. **(20 Marks)**

4 a. In a four bar mechanism, the crank $O_2A$ is 300 mm long, $AB = O_4B = 360$ mm and $O_2O_4$ the fixed link is 600 mm long. The crank makes an angle of 60° with the fixed link, and it rotates uniformly at 100 rpm. Locate all the instantaneous centers and find the angular velocity of links AB. **(10 Marks)**

b. A reciprocating engine mechanism has connecting rod 200 mm long and crank 50 mm long. By using KLEIN's construction, determine the velocity and acceleration of piston, and angular acceleration of connecting rod, when the crank has turned through 45° from IDC clockwise and is rotating at 240 rpm. **(10 Marks)**

### PART – B

5 a. Explain the significance of loop closure equation with an example. **(05 Marks)**

b. The crank of an engine mechanism is 200 mm long and the ratio of connecting rod length to the crank radius is 4. Determine the acceleration of the piston when the crank has turned through an angle 45° from inner dead centre and rotating at a speed of 240 rpm ccw by complex algebra approach. **(15 Marks)**

6 a. State and prove law of gearing. **(06 Marks)**

b. A pinion having 20 teeth of involute form, 20° pressure angle and 6 mm module drives gear teeth having 40 teeth. If addendum is equal to module, find i) addendum and pitch circle radii of the two gears ii) length of path of approach iii) length of path of contact iv) length of arc of contact. **(14 Marks)**

7 a. Explain different types of gear trains with neat sketches. **(06 Marks)**

b. A fixed annular gear A and a smaller concentric rotating gear B are connected by a compound gear C & D. The gear C mesh with gear A and D with B. The compound gears revolved in a pin on the arm R, which revolves about the axis of A & B. The number of teeth on gears A, B & D are 150, 40 and 100 respectively. Determine the number of teeth on gear C, if the gears A & C have twice the module of gears B & D. How many revolutions will be make for one complete revolution of the arm R? **(14 Marks)**

8 Draw the profile of a cam operating a roller follower and with the following data: Minimum radius of cam = 25 mm. Lift = 30mm, roller diameter = 15mm. The cam lifts the follower for 120° with SHM followed by a dwell period of 30°, then the follower lowers down during 150° of the cam rotation with UARM followed by a dwell period. The cam rotates at a uniform speed of 150 rpm (cw direction). The axis of the follower passes through the axis of the cam shaft. Calculate the maximum velocity and acceleration of the follower during descent period. **(20 Marks)**

* * * * *

USN | | | | | | | | | | |

06ME46B

# Fourth Semester B.E. Degree Examination, January 2013
## Fluid Mechanics

Time: 3 hrs. Max. Marks:100

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



### PART – A

1 a. Explain the following properties:
i) Cavitation ii) Vapour pressure iii) Surface tension iv) Viscosity. **(06 Marks)**

b. Explain the phenomenon of capillarity. Obtain an expression for capillary rise of a liquid. **(06 Marks)**

c. A cylinder of 0.30m diameter rotates concentrically inside a fixed cylinder of 0.31 m diameter. Both the cylinders are 0.3m long. Determine the viscosity of the liquid which fills the space between cylinders if a torque of 0.98 N-m is required to maintain a rotational speed of 60 rpm. **(08 Marks)**

2 a. State Pascal's law and give two examples where this principle is applied. **(04 Marks)**

b. With a neat sketch, explain the working of a U-tube differential manometer. **(06 Marks)**

c. Explain the following terms:
i) Metacentre ii) Buoyancy **(04 Marks)**

d. Find the total pressure and position of centre of pressure on a triangular plate of base 2 m and height 3 m which is immersed in water such a way that the plan of the plate makes an angle of 60° with the free surface of the water. The base of the plate is parallel to water surface and at a depth of 2.5 m from water surface. **(06 Marks)**

3 a. Distinguish between:
i) Steady flow and unsteady flow
ii) Laminar flow and turbulent flow
iii) Rotational flow and irrotational flow. **(06 Marks)**

b. Derive the general form of continuity equation for a three dimensional fluid flow. **(06 Marks)**

c. The velocity components in a two-dimensional flow field for an incompressible fluid are expressed as $u = \frac{y^3}{3} + 2x - x^2y$; $v = xy^2 - 2y - \frac{x^3}{3}$
i) Show that these functions represent a possible case of an irrotational flow.
ii) Obtain an expression for stream function. **(08 Marks)**

4 a. Explain the following :
i) Geometric similarity ii) Kinematic similarity iii) Dynamic similarity. **(06 Marks)**

b. Define and derive expressions for the following dimensionless numbers:
i) Reynolds number ii) Froud's number. **(06 Marks)**

c. The pressure difference $\Delta P$ in a pipe of diameter D, and length L due to turbulent flow depends on the velocity V, viscosity $\mu$, density $\rho$, and roughness k. Using Buckingham's $\pi$-theorem, obtain an expression for $\Delta P$. **(08 Marks)**

## PART – B

5 a. Derive Euler's equation of motion for steady flow and obtain Bernoulli's equation from it. State the assumptions made in the derivation of Bernoulli's equation. **(12 Marks)**

b. A conical tube is fixed vertically with its smaller end upwards. The velocity of flow down the tube is 4.5 m/s at the upper end and 1.5 m/s at the lower end. The tube is 1.5m long and the pressure head at the upper end is 3.1m of the liquid. The loss in the tube expresses as ahead is $\frac{0.3(V_1 - V_2)^2}{2g}$, where $V_1$ and $V_2$ are the velocities at the upper and lower ends respectively. What is the pressure head at the lower end? **(08 Marks)**

6 a. Derive Darcy-Weisbach equation for head loss due to friction in pipe flow. **(10 Marks)**

b. 215 litres of gasoline (specific gravity 0.82) flow per second upwards in an inclined venturimeter fitted to a 300 mm diameter pipe. The venturimeter is inclined at 60° to the vertical and its 150 mm diameter throat is 1.2m from the entrance along its length. Pressure gauges inserted at entrance and throat show pressures of 0.141 N/mm$^2$ and 0.77 N/mm$^2$ respectively. Calculate the coefficient of discharge of venturimeter. If instead of pressure gauges the entrance and throat of the venturimeter are connected, determine its reading in mm of differential mercury column. **(10 Marks)**

7 a. Derive Hagen-Poiseuille equation for pipe flow through circular pipes. **(10 Marks)**

b. Water at 15°C flows between two large parallel plates at a distance of 1.6mm apart. Determine i) the maximum velocity ii) the pressure dropper unit length and iii) the shear stress at the walls of the plates if the average velocity is 0.2 m/s. The viscosity of water at 15°C is given as 0.001 N-s/m$^2$. **(06 Marks)**

c. Sketch velocity and shear stress distribution across the section of two fixed parallel plates. **(04 Marks)**

8 a. Define the following terms:
i) Displacement thickness ii) Momentum thickness iii) Energy thickness. **(06 Marks)**

b. Distinguish between:
i) Streamlined body and bluff body ii) Friction drag and pressure drag. **(08 Marks)**

c. Calculate the Mach number at a point on a jet propelled aircraft, which is flying at 1100 km/hour at sea-level where air temperature is 20°C. Assume $\gamma = 1.4$ and R= 287 J/kgK. **(06 Marks)**

* * * * *