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10MAT31

Third Semester B.E. Degree Examination, June/July 2016
Engineering Mathematics – III

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Find the Fourier series for the function $f(x) = x(2\pi - x)$ in $0 \le x \le 2\pi$. Hence deduce that $\frac{\pi^2}{8} = 1 + \frac{1}{3^2} + \frac{1}{5^2} + - - - - -$. **(07 Marks)**

b. Find the half-range cosine series for the function $f(x) = (x-1)^2$ in $0 < x < 1$. **(06 Marks)**

c. Obtain the constant term and the co-efficient of the 1st sine and cosine terms in the Fourier series of y as given in the following table. **(07 Marks)**

x	0	1	2	3	4	5
y	9	18	24	28	26	20

2 a. Solve the integral equation :

$$\int_0^\infty f(\theta(\cos\alpha\,\theta\,d\theta = \begin{cases} 1-\alpha, & 0 \le \alpha \le 1 \\ 0, & \alpha > 1 \end{cases}$$

. Hence evaluate $\int_0^\infty \frac{\sin^2 t}{t^2}\,dt$. **(07 Marks)**

b. Find the Fourier transform of $f(x) = e^{-|x|}$. **(06 Marks)**

c. Find the infinite Fourier cosine transform of e^{-x^2}. **(07 Marks)**

3 a. Solve two dimensional Laplace equation $u_{xx} + u_{yy} = 0$ by the method of separation of variables. **(07 Marks)**

b. Obtain the D'Alembert's solution of the wave equation $u_{tt} = C^2 u_{xx}$ subject to the conditions $u(x, 0) = f(x)$ and $\frac{\partial u}{\partial t}(x,0) = 0$. **(06 Marks)**

c. Solve the boundary value problem $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}$, $0 < x < \ell$ subject to the conditions $\frac{\partial u}{\partial x}(0,t) = 0$; $\frac{\partial u}{\partial x}(\ell,t) = 0$, $u(x, 0) = x$. **(07 Marks)**

4 a. Find the equation of the best fit straight line for the following data and hence estimate the value of the dependent variable corresponding to the value of the independent variable x with 30. **(07 Marks)**

x	5	10	15	20	25
y	16	19	23	26	30

b. Solve by graphical method :
Max Z = x + 1.5 y
Subject to the constraints $x + 2y \le 160$
$3x + 2y \le 240$
$x \ge 0$; $y \ge 0$. **(06 Marks)**

c. Solve by simplex method :
max z = 3x + 5y
subject to $3x + 2y \le 18$
$x \le 4$
$y \le 6$
$x, y \ge 0$. **(07 Marks)**

PART – B

5 a. Using the method of false position, find a real root of the equation $x \log_{10} x - 1.2 = 0$, correct to 4 decimal places. **(07 Marks)**

b. By relaxation method, solve :
$10x + 2y + z = 9$; $x + 10y - z = -22$; $-2x + 3y + 10z = 22$. **(06 Marks)**

c. Find the largest Eigen value and the corresponding Eigen vector for the matrix $\begin{bmatrix} 6 & -2 & 2 \\ -2 & 3 & -1 \\ 2 & -1 & 3 \end{bmatrix}$ using Rayleigh's power method, taking $x_0 = [1\ 1\ 1]^T$. Perform 5 iterations. **(07 Marks)**

6 a. Find the cubic polynomial by using Newton's forward interpolation formula which takes the following values.

x	0	1	2	3
y	1	2	1	10

Hence evaluate f(4). **(07 Marks)**

b. Using Lagrange's formula, find the interpolating polynomial that approximate the function described by the following table.

x	0	1	2	5
f(x)	2	3	12	147

Hence find f(3). **(06 Marks)**

c. Evaluate $\int_4^{5.2} \log_e x \, dx$ using Weddler's rule by taking 7 ordinates. **(07 Marks)**

7 a. Solve $u_{xx} + u_{yy} = 0$ in the following square Mesh. Carry out two iterations. **(07 Marks)**

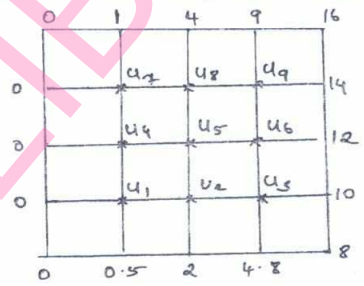

Fig. Q7(a)

b. The transverse displacement of a point at a distance x from one end to any point 't' of a vibrating string satisfies the equation : $\frac{\partial^2 u}{\partial t^2} = 25\frac{\partial^2 u}{\partial x^2}$ with boundary condition u(0, t) = u(5, t) = 0 and initial condition $u(x, 0) = \begin{cases} 20x & \text{for } 0 \le x \le 1 \\ 5(5-x) & \text{for } 1 \le x \le 5 \end{cases}$ and $u_t(x, 0) = 0$ solve by taking h = 1, k = 0.2 upto t = 1. **(06 Marks)**

c. Find the solution of the equation $u_{xx} = 2u_t$ when u(0, t) = 0 and u(4, t) = 0 and u(x, 0) = x(4 – x) taking h = 1. Find values upto t = 5. **(07 Marks)**

8 a. Find the Z – transformation of the following : i) $3n - 4\sin\frac{\pi}{4} + 5a^2$ ii) $\frac{a^n e^{-a}}{n!}$. **(07 Marks)**

b. Find the inverse Z – transformation of $\frac{4z^2 - 2z}{z^3 + 5z^2 + 8z - 4}$. **(06 Marks)**

c. Solve the difference equation : $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$; given $y_0 = y_1 = 0$ using Z – transformation. **(07 Marks)**

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10CV32

Third Semester B.E. Degree Examination, June/July 2016

Building Materials and Construction Technology

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Define foundation and enumerate the objectives of the foundations. (05 Marks)

b. What is safe bearing capacity of soil? List the types of methods adapted to examination of ground and explain any two of them. (07 Marks)

c. List the types of foundation and explain any two of them with neat sketches. (08 Marks)

2 a. Explain the classification of stone masonry with neat sketches. (08 Marks)

b. Explain: i) Queen closer ii) King closer, with neat sketches. (04 Marks)

c. Explain any two of the following :
i) English Bond ii) Flemish Bond iii) Cavity walls. (08 Marks)

3 a. Write a neat diagram of segmental arch and label it. (04 Marks)

b. List the classification of arches and explain any one of them in detail. (08 Marks)

c. Write short notes on: i) Chejja ii) Canopy iii) Balcony iv) Lintels (08 Marks)

4 a. Define a pitched roof and explain its various types. (10 Marks)

b. Give a list of materials which are commonly used as floorings and give a brief description of any four of them in detail. (10 Marks)

PART – B

5 a. Explain with neat sketches of i) Ledged and braced doors ii) skylights. (08 Marks)

b. Discuss the provisions of doors and windows with respect to the following :
i) Location ii) Size. (05 Marks)

c. Explain the properties of materials used in doors and windows. (07 Marks)

6 a. Explain the requirements of a good staircase. (04 Marks)

b. List the types of stairs and explain with neat sketches of Dog-legged stairs and circular stairs. (10 Marks)

c. The inside dimensions of a stair case in a residential building are 2.0 m × 4.60 m. The height of floor is 3.30 m and the roof consists of RCC slab is 12 cms thickness. Design a proper layout of dog legged staircase for this building. (06 Marks)

7 a. Mention the tools which are required in the plastering work. (04 Marks)

b. Enumerate the defects found in plastering work. (08 Marks)

c. Explain briefly painting on different surfaces. (08 Marks)

8 a. Differentiate between the following :
i) Formwork and Scaffolding ii) Damp-proofing and Water – proofing. (12 Marks)

b. Write short notes on : i) Form work for columns ii) Effects of dampness. (08 Marks)

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10CV33

Third Semester B.E. Degree Examination, June/July 2016
Strength of Materials

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Draw the stress versus strain curve for mild steel specimen subjected to axial tension and indicate the salient points. **(05 Marks)**

b. Derive an expression for the deformation of the tapering circular bar subjected to an axial force P. Use standard notations. **(08 Marks)**

c. The bar shown in fig. Q1(c) is tested in a universal testing machine. It is observed that at a load of 40kN the total extension is 0.285mm. Determine the Young's modulus of the material. **(07 Marks)**

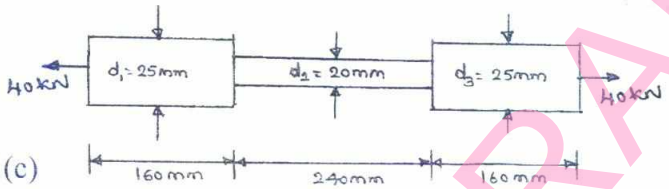

Fig.Q1(c)

2 a. Derive relation between Modulus of Rigidity, Young's modulus and Poisson's ratio. **(06 Marks)**

b. A steel rod is of 20m long at a temperature of 20^0C. Find the free expansion of the bar, when the temperature is raised to 65^0C. Also calculate the temperature stress produced for the following cases : i) When the expansion of the rod is prevented ii) When the rod is permitted to expand by 5.8mm. Take $\alpha = 12 \times 10^{-6}/^0$C and E = 200 GPa. **(06 Marks)**

c. A load of 2MN is applied on a column 500mm × 500mm. the column is reinforced with four steel bars of 10mm diameter, one in each corner. Find the stresses in the concrete and steel bars. Take E for steel as 2.1×10^5N/mm^2 and for concrete as 1.4×10^4N/mm^2. **(08 Marks)**

3 a. Define : i) Principal plane ii) Principal stresses. **(04 Marks)**

b. Determine the magnitude and direction of resultant stresses on a plane inclined at an angle of 60^0 to major principal stress plane, when the bar is subjected to principal stresses at a point 200MPa tensile and 100MPa compressive. Also determine the resultant stress and its obliquity. **(06 Marks)**

c. Two wooden pieces 100mm × 100mm in cross section are glued together along line AB as shown in fig. Q3(c). What maximum axial force 'P' can be applied if the allowable shearing stress along AB is 1.2N/mm^2? **(10 Marks)**

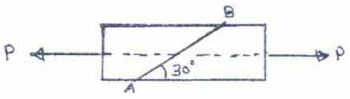

Fig.Q3(c)

4 a. Define i) Bending moment ii) Point of contraflexure. **(04 Marks)**

b. For the cantilever beam shown in fig. Q4(b), obtain SFD and BMD. **(06 Marks)**

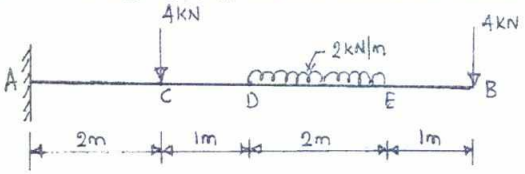

Fig.Q4(b)

c. Draw the Shear force and Bending moment diagrams for the beam shown in fig. Q4(c). **(10 Marks)**

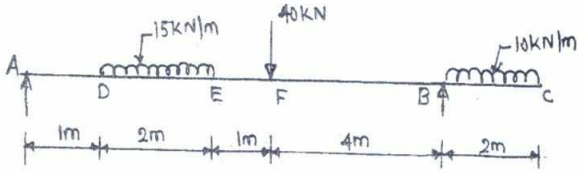

Fig.Q4(c)

PART – B

5 a. Derive the equation of theory of simple bending with usual notations. **(06 Marks)**

b. A simply supported beam of span 6m has a cross section as shown in fig. Q5(b), it carries two point loads each of 30kN at a distance of 2m from each support. Calculate the bending stress and shear stress for maximum values of bending moment and shear force respectively. Draw neat diagram of bending stress and shear stress distribution across the cross section. **(14 Marks)**

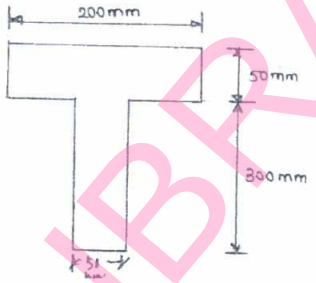

Fig.Q5(b)

6 a. Explain the terms : i) Slope ii) Deflection iii) Deflection curve. **(06 Marks)**

b. A simply supported beam 8m long, carries two concentrated loads of 80kN and 60kN at distances of 3m and 6m from left end support respectively. Calculate slope and deflection under loads. Given $E = 2.0 \times 10^5$ MPa and $I = 300 \times 10^6 mm^4$. **(14 Marks)**

7 a. State the assumptions made in the theory of Pure Torsion. **(04 Marks)**

b. A hollow shaft of internal diameter 400mm and external diameter 460mm is required to transmit power at 180rpm. Determine the power it can transmit, if the shear stress is not to exceed $60N/mm^2$ and the maximum torque exceeds the mean by 30%. **(06 Marks)**

c. A solid circular shaft is to transmit 250kN at 100 rpm. If the shear stress is not to exceed $75N/mm^2$, what should be the diameter of the shaft? If this shaft is to be replaced by a hollow one, whose internal diameter is 0.6 times external diameter, determine the size and percentage saving in weight, maximum shear stress being the same. **(10 Marks)**

8 a. Derive an expression for Euler's crippling load for a column with both ends fixed. **(08 Marks)**

b. Compare the crippling loads given by Euler's and Rankine's formula for a column of circular section 2.3m long and of 30mm diameter. The column is hinged at both ends. Take yield stress as $335N/mm^2$ and Rankine's constant $\alpha = \frac{1}{7500}$ and $E = 2 \times 10^5 N/mm^2$. For what ratio of L/K, the Euler's formula cease to apply for this column? **(12 Marks)**

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10CV34

Third Semester B.E. Degree Examination, June/July 2016
Surveying – I

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Distinguish between plane surveying and Geodetic surveying. **(06 Marks)**

b. Explain the terms : i) Accuracy ii) Precision iii) Discrepancy. **(06 Marks)**

c. A 30 meter chain was tested before the commencement of day's work and was found to be correct. After chaining 100 chains, the chain was found to be half decimeter too long. At the end of the day's work, after chaining another 100 chains, the chain was found to be one decimeter too long. What was the total true distance chained? **(08 Marks)**

2 a. State the important points considered while selecting main stations in surveying. **(06 Marks)**

b. With neat sketch, explain reciprocal ranging. **(06 Marks)**

c. A 20m steel tape standardized at 13.5°C under a pull of 100N was used for measuring a base line. Find the correction per tape length if the field temperature is 20°C under an applied pull of 160N. Assume area of tape as $0.02cm^2$, weight of tape 8N, $E = 2.11\times10^7$ N/cm^2, $\alpha = 6.2\times10^{-6}/°C$. **(08 Marks)**

3 a. With a neat sketch, explain the working of prism square. **(06 Marks)**

b. Define: i) Survey lines ii) Check lines iii) Tie lines. **(06 Marks)**

c. Stations A and D are on the opposite sides of a pond. A line AB, 200m long and another line AC 250m long are laid to the left and right of AD respectively. Further, the station points B, D and C are set perpendicular to AD such that BD = 125 m and DC = 150 m. Find the true length of AD. **(08 Marks)**

4 a. Distinguish between :
i) Magnetic meridian and True meridian
ii) WCB and QB **(04 Marks)**

b. A compass traverse survey ABCDEA was run in anticlockwise direction and the following bearings were taken suspecting local attraction.

Line	FB	BB
AB	150°00′	329°45′
BC	77°30′	256°00′
CD	41°30′	222°45′
DE	314°15′	134°45′
EA	220°15′	40°15′

Determine the local attraction and the corrected bearings. **(10 Marks)**

c. In an old map, a line AB was drawn to a magnetic bearing of 8°30′ when the magnetic declination was 1°E. To what magnetic bearing should the line be set now if the present magnetic declination is 11°30′ E? **(03 Marks)**

d. The true bearing of line is 48°24′. Calculate the magnetic bearing if the magnetic declination is 5°38′E. **(03 Marks)**

PART – B

5 a. What is local attraction? How is it determined and eliminated? **(08 Marks)**

b. Define :

i) Dependent co-ordinates

ii) Independent co-ordinates. **(04 Marks)**

c. In the following traverse PQRST, the length and the bearing of side TP is omitted. Calculate the length and bearing of line TP.

Line	Length (m)	Bearing
PQ	204.00	87°30′
QR	226.00	20°20′
RS	187.00	280°0′
ST	192.00	210°3′
TP	?	?

(08 Marks)

6 a. Illustrate with neat sketches :

i) Profile leveling

ii) Differential leveling

iii) Reciprocal leveling and

iv) Block leveling **(08 Marks)**

b. An observer standing on the deck of a ship just sees the top of light house which is 40m above the sea level. If the height of the observer's eye is 8m above the sea level, determine the distance of the observer from the light house. **(04 Marks)**

c. Two points A and B, 1530m apart are separated by a wide river. The following reciprocal levels were taken with one level :

Instrument at	Staff readings at	
	A	B
A	3.810m	2.165m
B	2.355m	0.910m

The collimation error was – 0.0004m per 100m. Calculate the true level difference between A and B and the refraction. **(08 Marks)**

7 a. Define contour. List the uses of contour maps. **(06 Marks)**

b. Explain the characteristics of contours. **(06 Marks)**

c. The following readings were taken consecutively with a 5m level staff on a continuously sloping ground at a common interval of 20m : 0.385, 1.030, 1.925, 2.825, 3.730, 4.685, 0.625, 2.005, 3.110, 4.485. The RL of first point is 208.125m. Rule out a page of the level field book and enter the readings. Calculate the RL of the points by rise and fall method only and hence determine the gradient of the line joining the first and last point. **(08 Marks)**

8 a. Explain with neat sketch, the procedure for:

i) Radiation method ii) Intersection method in plane table surveying **(08 Marks)**

b. What do you mean by orientation of plane table? Explain the different methods of orientation? **(10 Marks)**

c. Define Resection and hence state three point problem. **(02 Marks)**

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10CV36

Third Semester B.E. Degree Examination, June/July 2016
Applied Engineering Geology

Time: 3 hrs. Max. Marks:100

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

PART – A

1 a. Discuss in brief, the different branches of geology which are related to civil engineering. **(10 Marks)**

b. Write the chemical composition, crystal system and uses of any two of the following minerals – Agate , Orthoclase feldspar. Talc, Calcite. **(05 Marks)**

c. Discuss in brief, the different discontinuities traced within the earth's interior. **(05 Marks)**

2 a. Write the forms of igneous bodies with neat sketches. **(10 Marks)**

b. Write the role of metamorphic agents in metamorphism. **(06 Marks)**

c. Write a brief note on Exogenous and Endogenous geological agents. **(04 Marks)**

3 a. Write a brief note on soil profile. Discuss the factors which contribute for the formation of soil. **(08 Marks)**

b. Discuss Meanders and Oxbow lake, with neat sketches. **(06 Marks)**

c. What is Unconformity? What is its significance in civil engineering? **(06 Marks)**

4 a. What is an Earthquake? Discuss the preventive measures to be taken during construction of building in seismic zones? **(08 Marks)**

b. Discuss the different seismic zones of India. **(06 Marks)**

c. Explain the causes and effects of an Earthquake. **(06 Marks)**

PART – B

5 a. What are the qualities that are required for the selection of rocks as construction materials? **(08 Marks)**

b. Define Fault. How are they formed and their effects in civil engineering? **(08 Marks)**

c. Write a brief note on Joints in rocks and their significance in a reservoir site. **(04 Marks)**

6 Critically examine the following with suitable reason :

a. Sedimentary rock dipping downstream are ideal for dam sites.

b. Reservoir along the course of effluent streams are better than those on the valleys of influent rivers. Justify.

c. Stability of a tunnel alignment along a seismic zone.

d. Silting up of reservoir is a good sign for the safety of the dam. **(20 Marks)**

7 a. Write a brief note on water dousing or superstitious method of finding water. **(04 Marks)**

b. What is an Aquifer? Write a note on confined and unconfined aquifer, with a neat sketch. **(08 Marks)**

c. What is Rain water harvesting? Discuss the various types of artificial recharge. **(08 Marks)**

8 a. What is Remote Sensing? Discuss its applications in civil engineering. **(08 Marks)**

b. Write a note on impact of mining on environment. **(06 Marks)**

c. What is GIS? Write its use in civil engineering. **(06 Marks)**

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10CV35

Third Semester B.E. Degree Examination, June/July 2016
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. Distinguish between : i) Ideal fluids and real fluids ii) Surface tension and capillarity **(06 Marks)**

b. Prove that the relationship between surface tension and pressure inside a droplet of liquid in excess of outside pressure is given by, $P = \frac{4\sigma}{d}$. **(06 Marks)**

c. A 400 mm diameter staff is rotating at 200 mm in a bearing of length 120 mm. If the thickness of oil film is 1.5 mm and the dynamic viscosity of the oil is 0.7 N/m^2 determine:
i) Torque required to overcome friction in bearing
ii) Power utilized. **(08 Marks)**

2 a. Differentiate between : i) Absolute and gauge pressure ii) Simple manometer and differential manometer and iii) Piezometer and pressure gauges. **(06 Marks)**

b. What is the difference between U-tube differential manometers and inverted U-tube differential manometers? Where are they used? **(06 Marks)**

c. A single column manometer is connected to a pipe containing oil of specific gravity 0.8. The ratio of reservoir area to the limb is 100. The liquid level in the reservoir is 300 mm below the centre of the pipe containing oil and level of liquid in the right liquid limb is 500 mm above the liquid level in the reservoir. Determine the pressure of liquid in the pipe. The liquid in the reservoir and right limb is mercury with its sp.gr. as 13.6. **(08 Marks)**

3 a. Derive an expression for the depth of centre of pressure from free surface of liquid of an inclined plane surface submerged in the liquid. **(12 Marks)**

b. Find the magnitude and direction of the resultant force due to water acting on a roller gate of cylindrical form of 4 m diameter, when the gate is placed on the dam in such a way that water is just going to spill. Take the length of the gate as 8 m. **(08 Marks)**

4 a. Differentiate between the Eulerian and Lagrangian methods of representing fluid flow. **(06 Marks)**

b. Show that streamlines and equipotential lines form a set of perpendicular lines. **(06 Marks)**

c. In a 2-D incompressible flow, the fluid velocity components are given by $u = x - 4y$ and $v = -y - 4x$. Show that velocity potential exists and determine its form as well as stream function. **(08 Marks)**

PART – B

5 a. Describe venturimeter and find an expression for discharge through ventimeter. **(06 Marks)**

b. The water is flowing through a tapering pipe having diameter 300 mm and 150 mm at section 1 and 2 respectively. The discharge through the pipe is 40 litres/sec. The section 1 is 10 m above the datum and section 2 is 6 m above datum. Find the velocity of pressure at section 2 if that at section 1 is 400 kN/m^2. **(08 Marks)**

c. A pitot tube is inserted in a pipe of diameter 30 cm. The static pressure in the pipe is 10 cm of mercury (vaccum). The stagnation pressure at the centre of the pipe recorded by the pitot tube is 0.981 N/cm^2. Calculate the discharge through the pipe, if the average flow velocity is 0.85 times the central velocity. Take $C_d = 0.98$. **(06 Marks)**

6 a. Distinguish between hydraulic gradient line and energy gradient line. **(06 Marks)**

b. Derive an expression for loss of head due to sudden enlargement in a pipe line. **(06 Marks)**

c. A pipe line of 0.6 m diameter is 1.5 km long. To augment the discharge, another pipeline of the same diameter is introduced parallel to the first in the second half of its length. Find the increase of discharge if $f = 0.04$ and head at the inlet is 30 m. **(08 Marks)**

7 a. Define various hydraulic coefficients of an orifice and derive the relation between them. **(06 Marks)**

b. Differentiate between a large and small orifice. Obtain an expression for discharge through a large rectangular orifice. **(06 Marks)**

c. Water under a constant head of 4.5 m discharges through an external cylindrical mouthpiece of 50 mm diameter and 150 mm long. If C_C for the orifice is 0.6, find (i) the discharge in litres per second and ii) the absolute pressure at the vena antracta. Assume atmospheric pressure to be 10.3 m of water. **(08 Marks)**

8 a. What are the advantages of triangular notch over a rectangular notch? **(06 Marks)**

b. A right angle triangular notch is used for measuring a discharge of 30 lps. An error of 1.5 mm was made while measuring the head over the notch. Calculate the percentage error in estimating the discharge. Take $C_d = 0.62$. **(06 Marks)**

c. A suppressed rectangular weir is constructed across a channel of 0.77 m width with a head of 0.39 m and the crest 0.6 m above the bed of the channel. Estimate the discharge over it. Consider the velocity of approach and assume $C_d = 0.623$. **(08 Marks)**

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MATDIP301

Third Semester B.E. Degree Examination, June/July 2016
Advanced Mathematics – I

Time: 3 hrs. Max. Marks:100

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

1 a. Express the complex number $\frac{(1+i)(1+3i)}{(1+5i)}$ in the form a + ib. **(06 Marks)**

b. Find the modulus and amplitude of $1 + \cos\theta + i\sin\theta$. **(07 Marks)**

c. Find the cube root of $1 - i$. **(07 Marks)**

2 a. Find the n^{th} derivative of $e^{ax}\cos(bx + c)$. **(06 Marks)**

b. Find the n^{th} derivative of $\frac{6x}{(x-2)(x+2)(x-1)}$. **(07 Marks)**

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

3 a. Find the angle of intersection of the curves $r^2\sin 2\theta = a^2$, $r^2\cos 2\theta = b^2$. **(06 Marks)**

b. Find the nodal equation of the curve $r(1 - \cos\theta) = 2a$. **(07 Marks)**

c. Expand log (secx) upto the term containing x^4 using Maclaurin's series. **(07 Marks)**

4 a. If $u = x^3 - 3xy^2 + x + e^x\cos y + 1$, show that $u_{xx} + u_{yy} = 0$. **(06 Marks)**

b. If $u = f\left(\frac{x}{y}, \frac{y}{z}, \frac{z}{x}\right)$, prove that $xu_x + yu_y + zu_z = 0$. **(07 Marks)**

c. Find $\frac{\partial(u,v,w)}{\partial(x,y,z)}$, where $u = x + y + z$, $v = y + z$, $w = z$. **(07 Marks)**

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

b. Evaluate $\int_0^2 \frac{x^4}{\sqrt{4-x^2}}dx$. **(07 Marks)**

c. Evaluate $\int_{-c}^{c}\int_{-b}^{b}\int_{-a}^{a}(x^2 + y^2 + z^2)\,dz\,dy\,dx$. **(07 Marks)**

6 a. Prove that: i) $\Gamma(n+1) = n\,\Gamma(n)$ and ii) $\Gamma(n+1) = n!$ for a positive integer n. **(06 Marks)**

b. Prove that $\beta(m, n) = \dfrac{\Gamma(m)\,\Gamma(n)}{\Gamma(m+n)}$. **(07 Marks)**

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

7 a. Solve $\dfrac{dy}{dx} = (9x + y + 1)^2$. **(06 Marks)**

b. Solve $ye^{xy}\,dx + (xe^{xy} + 2y)\,dy = 0$. **(07 Marks)**

c. Solve $\dfrac{dy}{dx} + y\cot x = \cos x$. **(07 Marks)**

8 a. Solve $\dfrac{d^2y}{dx^2} - 6\dfrac{dy}{dx} + 9y = 5e^{-2x}$. **(06 Marks)**

b. Solve $(D^2 - 4D + 13)y = \cos 2x$. **(07 Marks)**

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

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