

Sylhet Engineering College, Sylhet
(Shahjalal University of Science & Technology)
Department of Civil Engineering

Final Examination, 2023

Course No.: CE 405

Time: 03 (Three) hours

2nd Year 2nd Semester

Course Title: Mechanics of Solid II

Full Marks: 60

N.B. : (i) Answer any three questions from each PART

(ii) Use separate answer scripts for each PART

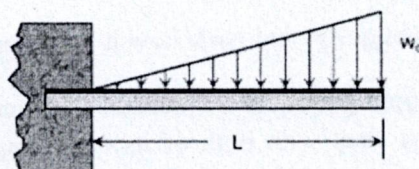
(iii) Marks allotted are indicated in the margin

(iv) Special Instruction (if any)-----N/A-----

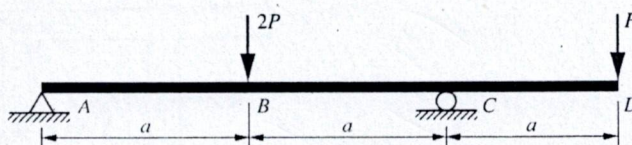
PART- A

(Answer any three questions)

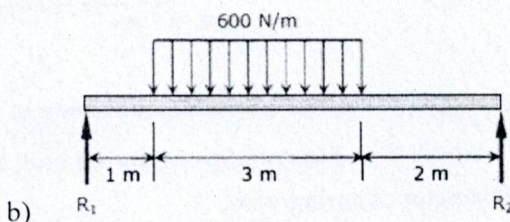
1. (a) Find the equation of the elastic curve for the cantilever beam shown below if it carries a load that varies from zero at the wall to w_0 at the free end. 05



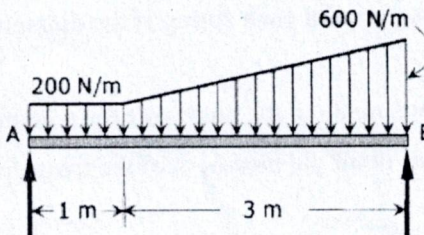
- (b) Determine an expression for the deflection of the right end of the beam shown below. 05



2. (a) Compute the midspan value of $EI\delta$ for the beam loaded as shown below. 05

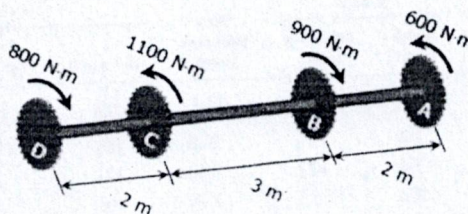


- (b) For the beam loaded as shown in below compute the moment of area of the M diagrams between the reactions about both the left reaction. 05



3. (a) A hollow 3-m-long steel shaft must transmit a torque of 25 kN-m. The total angle of twist in this length is not to exceed 2.5° and the allowable shearing stress is 90 MPa. Determine the inside and outside diameters of the shaft if $G = 85$ GPa. 05

- (b) An aluminum shaft with a constant diameter of 50 mm is loaded by torques applied to gears attached to it as shown. Using $G = 28$ GPa, determine the relative angle of twist of gear D relative to gear A. 05



4. (a) Using AISC column specifications, determine the safe axial loads on a W360 X 122 section used as a column under the following conditions: [Use $\sigma_{yp} = 380$ MPa and $E = 200$ GPa] 07

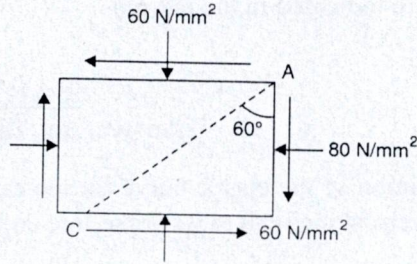
- i) Built-in ends and an unsupported length of 10 m
- ii) Built-in ends and a length of 10 m braced at the midpoint

- (b) Describe the limitations of Euler's formula. 03

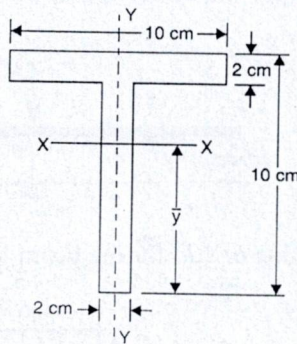
PART- B

(Answer any three questions)

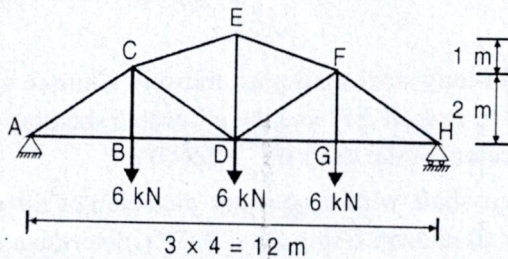
5. (a) The state of stress in a two dimensionally stressed material is as shown in Figure below. Determine the principal stresses, principal planes and the maximum shear stress. Determine normal and tangential stresses on plane AC also. 10



6. (a) Define the term 'obliquity' and write how it is determined. 03
- (b) Determine the crippling load for a T-section of dimensions 10 cm × 10 cm × 2 cm and of length 5 m when it is used as strut with both of its ends hinged. Take Young's modulus, $E = 2.0 \times 10^5$ N/mm². 07



7. (a) Prove that the deflection of a close-coiled helical spring at the centre due to axial load W is given by $\delta = \frac{64.W.R^3.n}{Cd^4}$ where R = Mean radius of spring coil, n = Number of coils, C = Modulus of rigidity, and d = Diameter of spring wire. 04
- (b) Two close-coiled concentric helical springs of the same length, are wound out of the same wire, circular in cross-section and supports a compressive load 'P'. The inner spring consists of 20 turns of mean diameter 16 cm and the outer spring has 18 turns of mean diameter 20 cm. Calculate the maximum stress produced in each spring if the diameter of wire = 1 cm and $P = 1000$ N. 06
8. (a) State the assumptions made in the analysis of pin jointed trusses. 02
- (b) Determine the forces in all the members of the truss given below. 08



Designation	Mass (kg/m)	Area (mm ²)	Depth (mm)	Flange		Web thickness (mm)	Axis X-X			Axis Y-Y		
				Width (mm)	Thickness (mm)		I (10 ⁶ mm ⁴)	$S = I/c$ (10 ³ mm ³)	$r = \sqrt{I/A}$ (mm)	I (10 ⁶ mm ⁴)	$S = I/c$ (10 ³ mm ³)	$r = \sqrt{I/A}$ (mm)
W250 × 167	167	21 200	290	264	31.8	19.2	298	2060	118	98.2	742	68.1
× 80	80.0	10 200	257	254	15.6	9.40	126	983	111	42.9	338	65.0
× 73	73.0	9 290	254	254	14.2	8.64	113	895	110	38.9	306	64.5
× 67	67.0	8 580	257	204	15.7	8.89	103	805	110	22.2	218	51.1
× 58	58.0	7 420	252	203	13.5	8.00	87.0	690	108	18.7	185	50.3
W310 × 107	107	13 600	312	305	17.0	10.9	248	1 600	135	81.2	531	77.2
× 97	97.0	12 300	307	305	15.4	9.91	222	1 440	134	72.4	477	76.7
W360 × 72	72.0	9 100	351	204	15.1	8.64	201	1 150	149	21.4	210	48.5
× 64	64.0	8 130	348	203	13.5	7.75	178	1 030	148	18.8	185	48.0
× 134	134	17 100	356	368	18.0	11.2	416	2 340	156	151	818	94.0
× 122	122	15 500	363	257	21.7	13.0	367	2 020	154	61.6	480	63.0

Sylhet Engineering College, Sylhet
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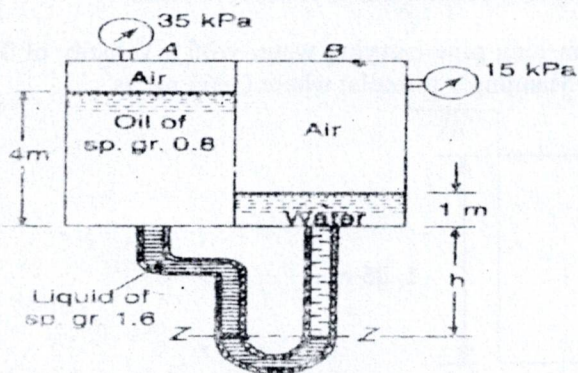
Department of Civil Engineering
 Final Examination, 2023 2nd Year 2nd Semester
 Course No.: CE 461 Course Title: Fluid Mechanics
 Time: 03 (Three) hours Full Marks: 60

N.B. : (i) Answer any three question from each PART (ii) Use separate answer scripts for each PART
 (iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)-----N/A-----

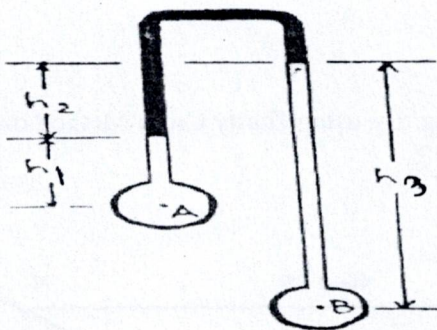
PART-A

(Answer any three questions)

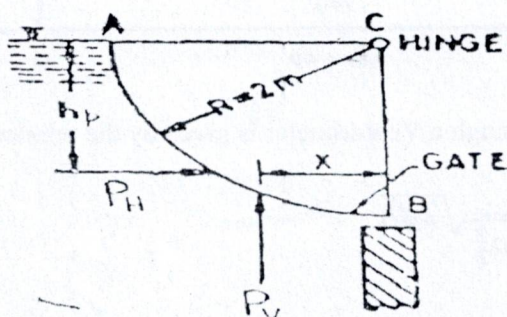
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|----|------|--|----|
| 1. | 1(a) | Write short notes on : (a) Viscosity (c) Capillarity | 02 |
| | 1(b) | Show that the relation of capillary rise in the water surface. | 03 |
| | 1(c) | A closed vessel is divided into two components. The components contain oil and water as shown in Fig. Determine the value of h, if the gauges show the readings as shown the Figure. | 05 |



- | | | | |
|----|------|--|----|
| 2. | 2(a) | State pascal's Law & Prove that the intensity of pressure at any point in a fluid at rest is the same in all directions. | 04 |
| | 2(b) | In the figure shown, the liquids at A and B are water and the manometer liquid is oil (sp. Gravity=0.8). (a) If $h_1=30$ cm, $h_2=20$ cm and $h_3=60$ cm, Determine $P_A- P_B$ (b) If $P_B=50$ KN/m ² and barometric pressure is 76 cm of Hg (sp. Gravity=13.6), find the pressure at A in m of water absolute. | 06 |



- | | | | |
|----|------|--|----|
| 3. | 3(a) | Prove that for inclined submerged surface center of pressure is always below the center of gravity and explain why? | 04 |
| | 3(b) | (a) Find the total pressure force acting on the gate per m length, which is a quadrant of a circular cylinder of radius 2 m as shown in the figure. (b) At what angle will be acting to the horizontal? (c) Prove that the resultant force passes through the hinge C. (d) Give the reason why the resultant passes through the hinge C. | 06 |

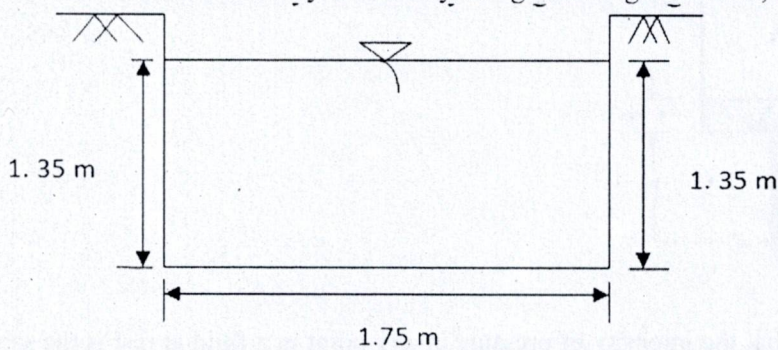


- 4 4(a) Define the coefficient of contraction, coefficient of velocity and coefficient of discharge. 02
- 4(b) What is the uses of Benoulli's equation for practical purposes? Derive the Bernoulli's equation $z_1 + \frac{p_1}{w} + \frac{v_1^2}{2g} = z_2 + \frac{p_2}{w} + \frac{v_2^2}{2g}$ with usual notations. 05
- 4(c) A rectangular orifice 2.5 m wide and 1.0 m deep is discharging water from a tank. If the water level in the tank is 2.5 m above the top edge of the orifice, find the discharge through the orifice. Take the coefficient of discharge for the orifice as 0.64. 03

PART-B

(Answer any three questions)

5. 5(a) State and prove Bernoulli's Equation with assumptions. 05
- 5(b) Drive the Equation Discharge Over a Triangular Notch or Weir, $Q = 1.417 H^{5/2}$ 05
6. 6(a) Drive Darcy-Weisbach formula for calculating loss of head due to friction in pipes. 05
- 6(b) A $(60 + 0.1 \times \text{last 2 digit your roll number})$ m long pipe carrying water with a velocity of 3.6 m/s. Determine the head loss by friction by using Manning's formula, where $C = 61 \text{ m}^{1/2}/\text{s}$ 05

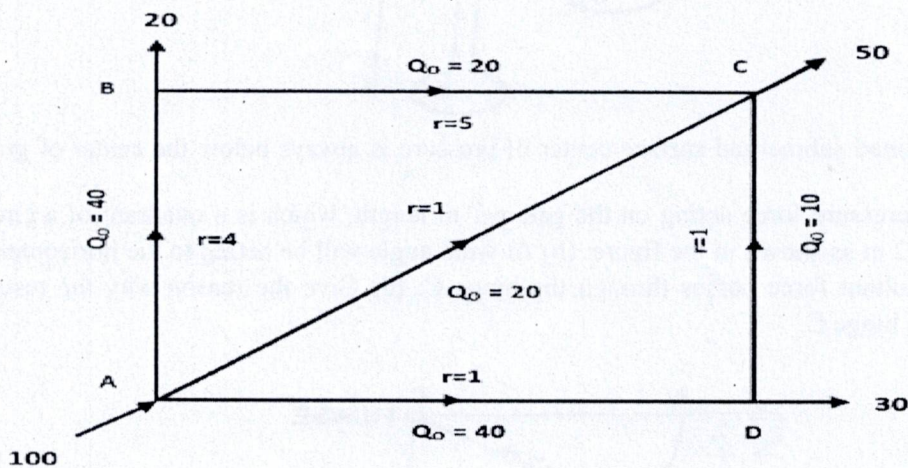


7. 7(a) Define the following terms : (i) Flow Net (ii) Path Line (iii) Rotation (iv) Stream line 04
- 7(b) What is dimensional homogeneity? Prove that the following equations are dimensionally homogeneous 06

i) $Q = A \times V$

ii) $H_f = \frac{4fLV^2}{2gd}$

8. 8(a) A pipe network shown in Fig. By using Hardy Cross Method determine the flow in each pipe. The value of n may be assume as 2. 05



- 8(b) Prove that discharge through a Venturimeter is given by the relation. 05

$$Q_{act} = C_d \frac{a_1 a_2}{\sqrt{a_1^2 - a_2^2}} \sqrt{2gh}$$

Sylhet Engineering College, Sylhet
(Shahjalal University of Science & Technology)
Department of Civil Engineering

Final Examination, 2023
 Course No.: CE 463
 Time: 02 (Two) hours

2nd Year 2nd Semester
 Course Title: Engineering Hydrology
 Full Marks: 40

N.B. : (i) Answer any two questions from each PART

(ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin

(iv) Special Instruction (if any)-----N/A-----

PART- A

(Answer any two questions)

- 1 (a) Describe the hydrologic cycle. Define catchment area. Explain water budget equation. 05
- (b) A catchment has six rain gauge stations. In a year, the annual rainfall recorded by the gauges are as follows: 05

Station	A	B	C	D	E	F
Rainfall (cm)	82.6	102.9	180.3	110.3	98.8	136.7

- (i) Determine the standard error in the estimation of mean rainfall in the existing set of rain gauges.
- (ii) For a 10% error in the estimation of the mean rainfall, calculate the optimum number of rain gauge stations in the catchment.

- 2 (a) Discuss the factors that affect the evaporation from a water body. How to reduce evaporation losses? 05
- (b) Calculate the potential evapotranspiration from an area near Sylhet in the month of November by Penman's formula. The following data are available: 05

Latitude	:28°4'N
Elevation	:230 m (above sea level)
Mean monthly temperature	:19° C
Mean relative humidity	:75%
Mean observed sunshine hours	:9 h
Wind velocity at 2 m height	:85 km/day
Nature of surface cover	:Close-ground green crop

[Extract necessary data from tables at the bottom of the question.]

3. (a) Define: Infiltration, Infiltrimeter, and Infiltration Index. What factors affect infiltration capacity? What is infiltration model equation? 04
- (b) A storm with 10.8 cm precipitation produces a direct runoff of 5.8 cm. Infiltration loss 1 cm. Given the 6 time distribution of the storm as below. Find ϕ and W indices. 06

Time from Start (h)	1	2	3	4	5	6	7	8
Incremental rainfall in each hour (cm)	0.4	0.9	1.5	2.3	1.8	1.6	1.0	0.5

PART- B

(Answer any two questions)

4. (a) Describe briefly the SCS-CN method of estimation of yield of catchment through use of daily rainfall record. 05
- (b) What is a hydrological drought? What are its components and their possible effects? 05
5. (a) Annual flood data of the river Surma covering the period 1948 to 1979 yielded for the annual flood discharges a mean of 29,600 m³/s and a standard deviation of 14,860 m³/s. For a proposed bridge on this river near this site it is decided to have an acceptable risk of 10% in its expected life of 50 years. 06
- (i) Estimate the flood discharge by Gumbel's method for use in the design of this structure.
- (ii) If the actual flood value adopted in the design is 125,000 m³/s what are the safety factor and safety margin relating to maximum flood discharge?
- [Given values, $Y_n = 0.5380$ and $S_n = 1.1193$]

(b) Explain elements of a Flood Hydrograph with figure

04

6. (a) What are the factors that affect runoff hydrograph. Explain these factors.

04

(b) Rainfall of magnitude 3.8 cm and 2.8 cm occurring on two consecutive 4-h durations on a catchment of area 27 km² produced the following hydrograph of flow at the outlet of the catchment. Estimate the rainfall excess and ϕ index.

Time from start of rainfall (h)	-6	0	6	12	18	24	30	36	42	48	54	60	66
Observed flow (m ³ /s)	6	5	13	26	21	16	12	9	7	5	5	4.5	4.5

Table 3.3 Saturation Vapour Pressure of Water

Temperature (°C)	Saturation vapour pressure e_s (mm of Hg)	A (mm/°C)
0	4.58	0.30
5.0	6.54	0.45
7.5	7.78	0.54
10.0	9.21	0.60
12.5	10.87	0.71
15.0	12.79	0.80
17.5	15.00	0.95
20.0	17.54	1.05
22.5	20.44	1.24
25.0	23.76	1.40
27.5	27.54	1.61
30.0	31.82	1.85
32.5	36.68	2.07
35.0	42.81	2.35
37.5	48.36	2.62
40.0	55.32	2.95
45.0	71.20	3.66

$$e_s = 4.584 \exp \left(\frac{17.27t}{237.3+t} \right) \text{ mm of Hg, where } t = \text{temperature in } ^\circ\text{C.}$$

Table 3.4 Mean Monthly Solar Radiation at Top of Atmosphere, H_a in mm of Evaporable Water/Day

North latitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0°	14.5	15.0	15.2	14.7	13.9	13.4	13.5	14.2	14.9	15.0	14.6	14.3
10°	12.8	13.9	14.8	15.2	15.0	14.8	14.8	15.0	14.9	14.1	13.1	12.4
20°	10.8	12.3	13.9	15.2	15.7	15.8	15.7	15.3	14.4	12.9	11.2	10.3
30°	8.5	10.5	12.7	14.8	16.0	16.5	16.2	15.3	13.5	11.3	9.1	7.9
40°	6.0	8.3	11.0	13.9	15.9	16.7	16.3	14.8	12.2	9.3	6.7	5.4
50°	3.6	5.9	9.1	12.7	15.4	16.7	16.1	13.9	10.5	7.1	4.3	3.0

Table 3.5 Mean Monthly Values of Possible Sunshine Hours, N

North latitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0°	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1
10°	11.6	11.8	12.1	12.4	12.6	12.7	12.6	12.4	12.9	11.9	11.7	11.5
20°	11.1	11.5	12.0	12.6	13.1	13.3	13.2	12.8	12.3	11.7	11.2	10.9
30°	10.4	11.1	12.0	12.9	13.7	14.1	13.9	13.2	12.4	11.5	10.6	10.2
40°	9.6	10.7	11.9	13.2	14.4	15.0	14.7	13.8	12.5	11.2	10.0	9.4
50°	8.6	10.1	11.8	13.8	15.4	16.4	16.0	14.5	12.7	10.8	9.1	8.1

Sylhet Engineering College, Sylhet
(Shahjalal University of Science & Technology)

Department of Civil Engineering

Final Examination, 2023

2nd Year 2nd Semester

Course No.: CE 481

Course Title: Engineering Geology & Geomorphology

Time: 02 (Two) hours

Full Marks: 40

N.B. : (i) Answer any two question from each PART (ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin (iv) Special Instruction (if any)-----N/A----

PART-A

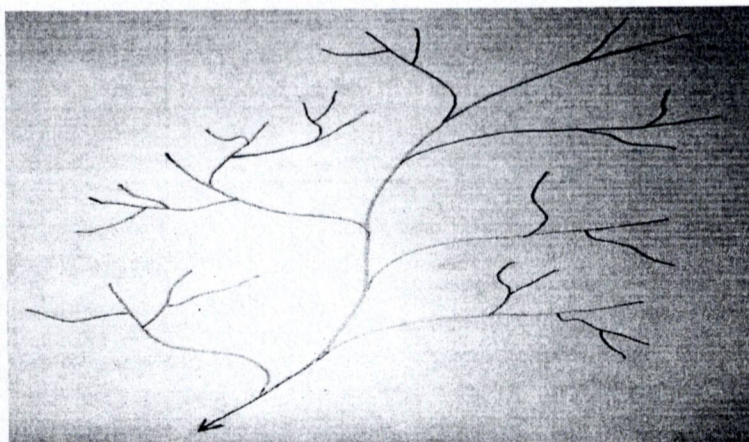
(Answer any two questions)

1. a. Write down the elements of geological map and write the importance of geologic structures. 4
- b. What are Minerals? Briefly describe the physical properties of minerals with examples. 6
2. a. Which elements present in minerals that are found as natural compounds? 5
- b. Define Mineraloids. Describe classification of minerals according to chemical composition. 5
3. a. What is a Rock? Briefly describe the geological classification rocks with example. 5
- b. Difference between Magma & Lava? What do you mean structural geology? Short Note: 1) Strike 2) Dip 5

PART-B

(Answer any two questions)

4. a. What types of faults are seen in natural mineral and rocks? Briefly describe five types of faults with Fig. 6
- b. What are the causes and effect that influence the occurrence folding of rocks? 4
5. a. Effects of Earthquake. Briefly describe types & causes of earthquake. 6
- b. Short notes features of river deposits: i) Delta ii) Natural Levees iii) Alluvial Cones iv) Alluvial Fans 4
6. a. Short Notes: i) ii) Basin iii) Junction iv) Links 2
- b. A drainage area 35000 sq miles of a rectangular shape. The drainage network receives water from this area length of 1st 2nd 3rd 4th 5th 6th order stream is 5.5, 25.2, 70.6, 202.1, 505.7 and 720.3 miles respectively. Length of drainage 225 miles. Find: i) No of streams ii) Average Bifurcation Ratio iii) Average length ratio iv) Drainage Density v) Stream frequency vi) Length of overland flow vii) Form Factor viii) Compactness Constant by using Strahler's Ordering. 8



Sylhet Engineering College, Sylhet
(Shahjalal University of Science & Technology)
Department of Civil Engineering

Final Examination, 2023

2nd Year 2nd Semester

Course No.: CE 403

Course Title: Mathematics for Engineer's

Time: 03 (Three) hours

Full Marks: 60

N.B. : (i) Answer any three questions from each PART

(ii) Use separate answer scripts for each PART

(iii) Marks allotted are indicated in the margin

(iv) Special Instruction (if any)-----N/A-----

PART- A

(Answer any three questions)

1. (a) Define with examples: i) Fourier series ii) periodic functions 03
 (b) Find the Fourier series of $f(x) = 0; -\pi < x < 0$ 07

$$\frac{\pi x}{4}; 0 < x < \pi$$
 and hence deduce that $\frac{\pi^2}{8} = 1 + \frac{1}{3^2} + \frac{1}{5^2} + \frac{1}{7^2} + \dots$
2. (a) Find the power series solution of $\frac{d^2y}{dx^2} - x \frac{dy}{dx} - (x^2 + 2)y = 0$ in ascending power of x. 05
 (b) State and prove Parseval's Identity. 05
3. (a) Express $x^4 + 3x^3 - x^2 + 5x - 2$ as a Legendre polynomial. 05
 (b) State and prove the Rodrigues's Formula. 05
4. (a) Using the Fourier cosine transformation solve: $\frac{\partial U}{\partial t} = \frac{\partial^2 U}{\partial x^2}$, $U_x(0, t) = 0$, $U_x(6, t) = 0$, $U(x, 0) = 2x$, $0 < x < 6$, $t > 0$. 06
 (b) Define Bessel function. Prove that $J_{\frac{1}{2}}(x) = \sqrt{\frac{2}{\pi x}} \sin x$ 04

PART- B

(Answer any three questions)

5. (a) Define Laplace transformation. Find the Laplace transformation of the followings: 04
 i) $t^3 e^{2t}$ ii) $e^{-4t} \cos 3t$
 (b) Using Laplace transformation solve the initial value problem: 06

$$Y'' - 3Y' + 2Y = 4e^{2t}, Y(0) = -3, Y'(0) = 5$$
6. (a) The joint probability density function of two random variables x and y is given by $f(x, y) = 4xy, 0 \leq x, y \leq 1$ 06
 Find $f(x), f(y), f\left(\frac{x}{y}\right)$ and $f\left(\frac{y}{x}\right)$.
 (b) A random variable x is normally distributed with Mean 12 and Standard Deviation 4. Find out the probability of (i) $x \geq 20$ (ii) $x \leq 20$. 04
7. (a) Define Poisson's distribution. Derive Poisson's distribution from Binomial distribution. 05
 (b) A manufacturer of pins knows that 5% of his product is defective. If he sells pins in boxes of 100 and guarantees that not more than 10 pins will be defective. What is the approximate probability that a box will fail to meet the guaranteed quality? 05
8. (a) Define probability density function. A random variable x has the following probability density function $f(x) = px(4-x); 0 \leq x \leq 4$. i) Determine p ii) Find the probability that $1 \leq x \leq \frac{3}{2}$. 05
 (b) Define Regression line. Find the equation of the regression line of x on y and that of y on x. 05