L-2/T-2/NAME **Date : 01/04/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2017-2018

Sub : **EEE 261** (Electrical and Electronic Technology for Marine Engineers)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

The symbols have their usual meanings.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Determine the voltages at all nodes and the currents through all branches for the current shown in Fig. 1(a). The minimum value of β is specified to be 30. **(18)**

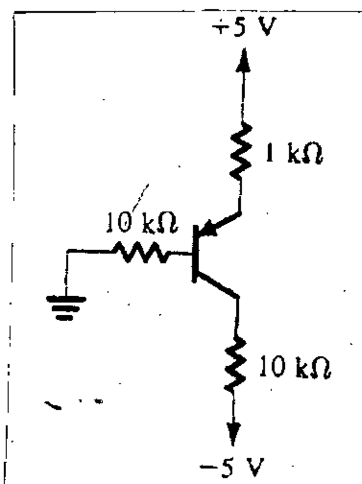

Figure for Q. 1(a)

(b) The transistor in the circuit of Fig. 1(b) has $\beta = 100$ and exhibits V_{BE} of 0.7 V at $I_C = 1$ mA. Design the circuit so that a current of 2 mA flows through the collector and a voltage of +5V appears at the collector. **(17)**

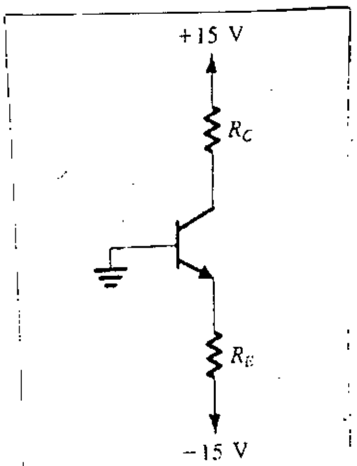

Figure for Q. 1(b)

2. (a) Describe the operation of an SCR with a two transistor model. **(10)**

(b) Define latching current and holding current of an SCR. Also, draw the I-V characteristics of an SCR. **(10)**

(c) Describe the natural and forced communication techniques of an SCR. **(15)**

Contd P/2

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3. (a) The NMOS and PMOS transistors in the circuit of Fig. 3(a) are matched with $k_n(W_n/L_n) = k_p(W_p/L_p) = 1$ mA/V^2 and $V_{tn} = -V_{tp} = 1$V. Assuming $\lambda = 0$ for both devices, find the drain currents i_{DN} and I_{DP}, as well as voltage v_O, for $v_I = 0$ V, +2.5 V, and –2.5. **(18)**

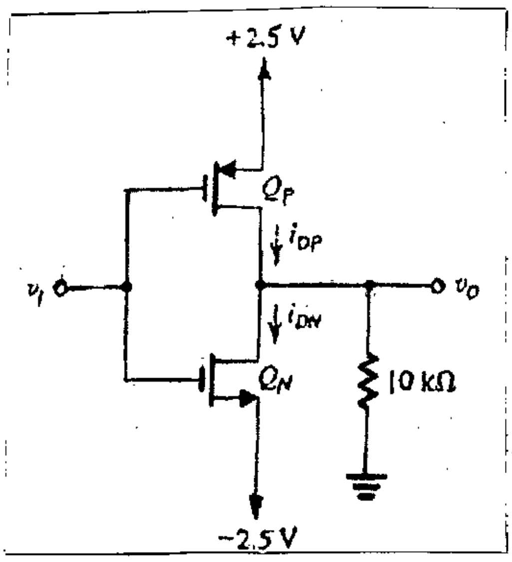

Figure for Q. 3(a)

(b) Determine the voltages at all nodes for the circuit of Fig. 3(b). Assume $V_t = 1$ V, $k_n(W_n/L_n) = 1$ mA/V^2 and $\lambda = 0$. **(17)**

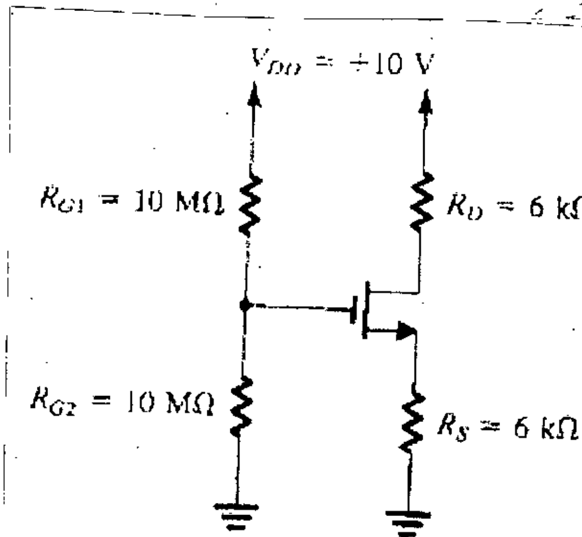

Figure for Q. 3(b)

4. (a) Assuming the diodes to be ideal, find the values of I and V in the circuit of Fig. 4(a). **(10)**

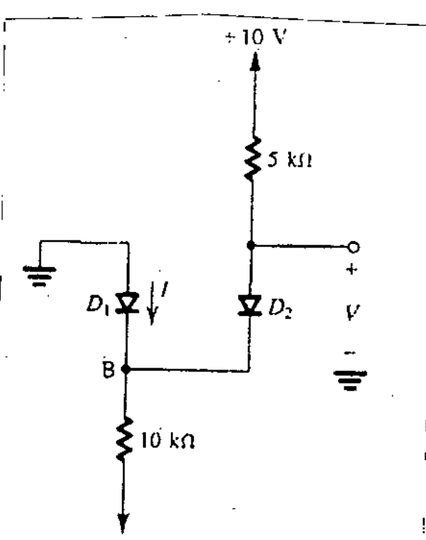

Figure for Q. 4(a)

Contd P/3

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Contd ... Q. No. 4

(b) For the circuit shown in Fig. 4(b), assume $V_B = 12$ V, $R = 100\ \Omega$, and $v_s(t) = 24 \sin(\omega t)$ V. Determine the peak diode current, maximum reverse-bias diode voltage, and the fraction of the cycle over which the diode is conducting. **(15)**

Assume that the diode is silicon-made and consider constant voltage drop model for calculation.

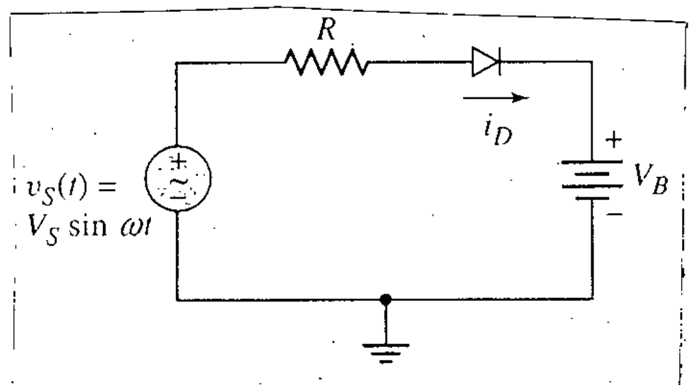

Figure for Q. 4(b)

(c) For the circuit shown in Fig. 4(c), assume $V_{PS} = 5$ V, $R = 5$ kΩ, and $v_i = 0.1 \sin(\omega t)$ V. Determine the DC and AC components of the output voltage v_O. Assume that the diode is silicon-made and consider constant voltage drop model for calculation. **(10)**

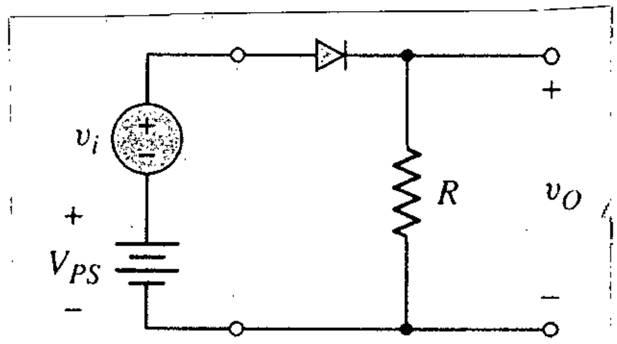

Figure for Q. 4(c)

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE**.

5. (a) Draw the equivalent circuit of an induction motor and find the Thevenin equivalent voltage V_{TH} and impedance Z_{TH} of the input side of an induction motor. Also show that maximum torque of an induction motor is given by **(18)**

$$\tau_{max} = \frac{3V_{TH}^2}{2\omega_{sync}\left[R_{TH} + \sqrt{R_{TH}^2 + \left(X_{TH} + X_2\right)^2}\right]}.$$

(b) A 230 V, 75 hp, three phase four-pole wye-connected wound-rotor induction motor has the following impedances in ohms per phase referred to the stator circuit: **(17)**

$R_1 = 0.058\ \Omega$	$X_M = 18\ \Omega$
$X_1 = 0.32\ \Omega$	$X_2 = 0.386\ \Omega$

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Contd ... Q. No. 5(b)

(i) What is the maximum torque of this motor?

(ii) Given that the slip is 3% at maximum torque, find the starting torque of this motor.

(iii) If the rotor resistance is doubled, what is the speed at which the maximum torque now occurs?

(iv) Draw the torque-speed characteristics of this motor, clearly showing the change due to increase in the rotor resistance.

6. (a) What is synchronous speed? What happens when an induction motor runs at synchronous speed? **(8)**

(b) Briefly explain the different characteristic regions in the torque-speed curve of an induction motor. **(8)**

(c) Describe, with a neat diagram the different types of speed control of a wound-rotor induction motor. Can the same methods be applied for a squirrel-cage induction motor? **(9)**

(d) A 20-hp, 50 Hz, two-pole three-phase induction motor drives a centrifugal pump at 2940 rpm. The stator copper losses are 2 kW and the rotor copper losses are 700 W. The friction and windage losses are 800 W and core losses are negligible. Find the slip, air-gap power and efficiency of the motor. **(10)**

7. (a) A synchronous generator is to be connected in parallel to an infinite bus. With the help of house diagram, explain what happens if the frequency of the incoming generator is slightly lower than the frequency of the infinite bus. What changes should the operator make to mitigate the issue? **(10)**

(b) With necessary house diagram and phasor diagrams, explain the load sharing of a synchronous generator working in parallel with an infinite bus. How should the field circuit be changed so that the generator provides reactive to the system? **(12)**

(c) A 2300 V, 100 kVA, 0.8 power factor lagging, 50 Hz, two-pole Y-connected synchronous generator has a synchronous reactance of 1.1 Ω and armature resistance of 0.15 Ω. Its friction and windage losses are 24 kW and its core losses are 18 kW. The field current of the generator is adjusted to achieve rated voltage of 2300 V at full-load condition. Find: **(13)**

(i) The efficiency of the generator at rated load.

(ii) The voltage regulation of the generator if it is loaded to rated kVA with 0.8 power factor lagging load.

(iii) The voltage regulation of the generator if it is loaded to rated kVA with 0.8 power factor leading load.

8. (a) With the help of phasor diagram, explain what are over-excited and under-excited operations of a synchronous motor. How is the power of a system improved using a synchronus motor. **(14)**

Contd P/5

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Contd ... Q. No.8

(b) A 208 V, 45 hp, 0.8 power factor leading, Δ-connected 60 Hz synchronous motor has a synchronous reactance of 2.5 Ω and negligible armature resistance. Its friction and windage losses are 1.5 kW and core losses are 1.0 kW respectively. Initially the shaft is supplying a 15-hp load at 0.95 power factor leading. **(21)**

(i) Find the values of I_A, I_L and E_A. Sketch the corresponding phase diagrams.

(ii) Assume that the shaft load is now increased to 40 hp. Find I_A, I_L, E_A and power factor after the load change.

(iii) The motor's flux is now increased by 25%. What are the new values of I_A, I_L, E_A and power factor of the synchronous motor?

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2017-2018

Sub: **NAME 217** (Theoretical Ship Design)

Full Marks: 210 Time : 3 Hours

The figures in the margin indicate full marks.

Assume reasonable values for missing data.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. (a) Distinguish between rule based and rationally based structurally design of a ship. Draw a flow diagram which shows the direct structural analysis of ship. **(20)**

   (b) Midship section of a ship is shown in Figure for Question No. 1(b). Find the section modulus of deck and keel. **(15)**

2. (a) Classify the resistance components of bare hull in calm water. A 6 m model of a 180 m long ship is towed in a model basin at a speed of 1.61 m/s. The towing pull is 20 N. The welled surface area of the model is $4m^2$. Estimate the corresponding speed for the ship in knots and the effective power, assuming resistance coefficients to be independent of scale for simplicity. **(25)**

   (b) For a new design, the naked effective power of a ship is 3200 kw. If the hull efficiency is 98.2%, propeller efficiency is 65.85%%, shaft losses is 4.75%, engine mechanical efficiency is 86.13%, weather and appendage allowances is 10%, calculate all powers from propeller tips to the engine room. **(10)**

3. (a) What is sea-keeping and maneuvering of ship? Discuss the physical significance of maneuvering. **(18)**

   (b) Discuss with figures the different types of Rudder used in ships. **(17)**

4. (a) Discuss the economical approaches in ship design procedures. What are the principal parameters to be considered in any marine transport system? **(20)**

   (b) 11,000 ton payload cargo ship makes 10 round voyages per annum with 65% load factor, The voyages costs are $28,000 per trip, annual operating costs $280,000 and trip freight rate is $16 per ton after commission. The ship cost is $3,000,000 and her expected life is 20 years, 9% discount rate, zero resale value and 50% tax rate. Calculate the net present value of cash flow using the following method: **(15)**

   (i) no tax and

   (ii) Straight line depreciation

Contd P/2

NAME 217

SECTION – B

There are **FOUR** questions in this Section. Answer any **THREE** questions.

5. (a) Explain how the length, breadth and depth of a ship affect most of the technical and economical performance. **(18)**

   (b) An oil tanker has the following information: **(17)**

   Length between perpendicular, LBGP = 264 m
   Breadth (Mld) = 40.7 m
   Depth (Mld) 22.0 m
   Summer load water line (SLWL) = 16.75 m
   Displacement = 151,000 tonnes
   Block coefficient@ SLWL = 0.820
   Water ballast tanks within the cargo tank network = 15,000 m^3
   Length of fore peak tank = 10 m
   Length of aft peak tank = 10 m
   Length of deep tanks forward = 10 m
   Length of engine room = 31 m
   Double bottom volume under main network of tanks = 16,000 m^3.
   Allow 2% expansion due to heat in the cargo oil tanks.

   Calculate the cargo oil capacity for this tanker.

6. (a) Draw a flow diagram of iteration procedure to satisfy the dimensional requirements of a ship. **(20)**

   (b) Data for a selected basis ship with diesel machinery is as follows: **(15)**

   Brake power = 4600 kW, displacement = 15272 tonnes,
   Service speed = 15.50 knotes and machinery
   Weight = 663 tonnes
   A new ship having similar design has:
   Displacement = 14733 tonnes, service speed = 15.25 knots. Estimate the machinery weight for the new design by using rate procedure.

7. (a) Write at least five characteristics of (i) Container ship and (ii) Oil tanker. **(18)**

   (b) Point out the steps useful for general arrangement design of a ship. **(17)**

8. (a) A basic general cargo ship has 137.5 m LBP, 19.75 m breadth (mld) with a final wood and outfit weight, 736 tonnes. A new similar ship has an LBP of 140.5 m and a breadth (mld) of 19.95 m. Estimate the wood and outfit weight using coefficient and proportional method for the new design. **(15)**

Contd P/3

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Contd. Q. No. 8

(b) An oil tanker has 155 m freeboard length with an actual bow height of 6.894 m and a block coefficient of 0.830. Superstructure length is 51% of the freeboard length. **(20)**

(i) Estimate the bow height meeting the minimum statuary requirements

(ii) Estimate the super structure correction to tabular free board.

For Q. No. 8(b)

[Bow height correction

If the bow height on the actual vessel is less than the standard bow height, then the freeboard must be increased.

If the bow height on the actual vessel is greater than the standard bow height, then there is no correction to be made to the freeboard.

The minimum bow height (mBH) for ships is as follows:

- If L_F is 250 m, then mBH = $56L\{1- L/500\} \times 1.36/(C_b + 0.680)$ mm.
- If LF 250 m or is 250 m, then mBH = $7000 \times 1.36/(Cb+0.680)$ mm.

Superstructure correction

Where the effective lengths of the superstructure and trunks is **100% LF**,
the freeboard can be reduced by:

350 mm when L_F is 24 m
860 mm when L_F is 85 m
1070 mm when L_F is 122 m and above

However, if less than 100% of the vessel's length is superstructure length, then the following multiple factors should be determined.

- For (E/L_F) of 0 to 0.3, the multiple factor is $70 \times (E/L_F)$ per cent.
- For (E/L_F) of 0.3 to 1.0 factor = $27.78(E/L_F)^2 + 76.11(E/L_F) - 3.89$ per cent.]

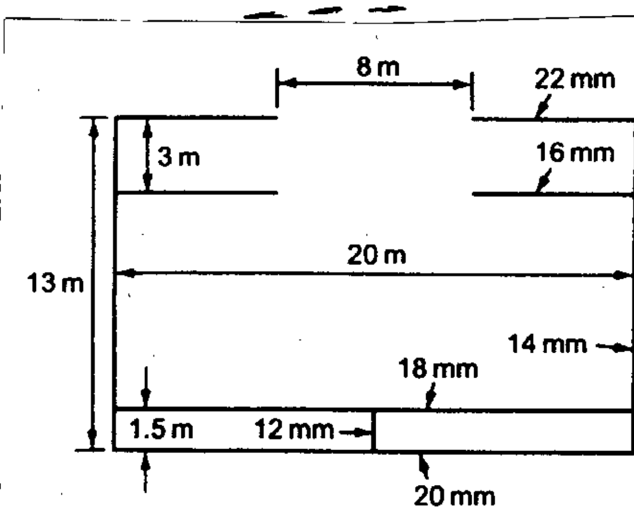

Figure for Question No. 1(b)

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BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2017-2018

Sub: **HUM 211** (Sociology)

Full Marks: 140 Time: 3 Hours

The figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. (a) 'Sociology is the study of social relationship' — justify this statement on the basis of nature of sociology. **(10)**

   (b) Critically explain the main features of functionalist theoretical perspective of sociology. **(13⅓)**

2. (a) 'Ethnocentrism is a habit to judge other's ways of life by the standards of our own group' — explain. **(10)**

   (b) What is cultural lag? Do you think cultural lag resist social change? Show arguments in favour of your answer. **(13⅓)**

3. (a) Define family. Explain the changing functions of family as a social organization. **(10)**

   (b) Discuss the recent trends of modern nuclear family. **(13⅓)**

4. Write short notes on **any three** of the following: **(23⅓)**

   (a) Types of social mobility.

   (b) Ascribed status and achieved status.

   (c) Caste system and class system.

   (d) Social norms.

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) How and why did the industrial revolution happen? **(13⅓)**

   (b) Discuss the key social characteristics of urban community? **(10)**

6. (a) Explain the general elements of systematic study of population. **(13⅓)**

   (b) Explain the reasons and consequences of rural to urban migration in Bangladesh. **(10)**

Contd P/2

HUM 211/NAME

7. (a) Illustrate the social impacts of globalization on developing nations. **(13 ⅓)**

   (b) Identify the fundamental differences between urban ecology and new urban sociology. **(10)**

8. Write short notes on **any three** of the following: **(23 ⅓)**

   (a) The concentric zone model.

   (b) Feudalism.

   (c) Capitalism.

   (d) Water pollution.

L-2/T-2/NAME **Date: 27/03/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2017-2018

Sub: **NAME 223** (Marine Hydrodynamics)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE** questions.

Symbols have their usual meaning. Assume reasonable value for any missing data.

1. (a) Derive Navier-Stokes equations from Euler's equations of motion for fluid flow. **(14)**

(b) Determine exact solution of Navier-Stokes equations for steady two-dimensional parallel flow between fixed parallel plates. **(14)**

(c) Explain boundary layer separation. **(7)**

2. (a) With neat sketches, describe different steps which transform the uniform flow to flow normal to a vertical plate or wall. **(12)**

(b) Elaborately explain graphical construction for transforming the a-circle into a circular arc. **(13)**

(c) What is the transformation for a flow at a wall angle? Show the flow patterns with neat sketches for n = 3, 2, 3/2, 2/3, 1/2, and 1/3. **(10)**

3. (a) Apply Kelvin's circulation theorem to analyze flow around a hydrofoil. **(15)**

(b) Derive the expression of lift coefficient for an infinite hydrofoil and based on the curve of lift coefficient explain what you recommend for the design of rudder-steering system. **(20)**

4. (a) What do you mean by 'virtual mass'? Derive the virtual mass of a cylinder of radius 'a' moving with a velocity, U through a fluid initially at rest. **(10)**

(b) How can you develop a pattern of flow past a Rankine body? Also determine the expressions of length, profile and width of the Rankine body. **(15)**

(c) The 3-plane pattern of a flow is given by $w = 3(z + 5/z)$. Determine the velocity V and the direction of flow, α at the point $z = 4 + 5i$. Repeat above calculation for $w = 3(z + 5/z) + 4i \ln z$ **(10)**

Contd P/2

NAME 223

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) Derive the condition for irrotationality in three-dimensional fluid flow. **(10)**

(b) Define "stream function". Write down the important properties of the stream function, in steady two-dimensional flow in the x-y plane. **(10)**

(c) Determine the stream function for parallel flow with a velocity V, inclined at an angle α to the x-axis, as shown in Fig. for Q. No. 5(c). **(15)**

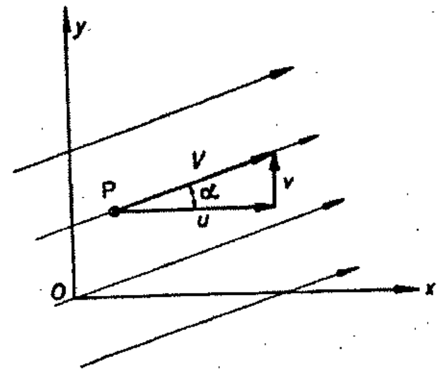

Fig. for Q. No. 5(c)

6. (a) With a neat sketch distinguish among streamlines, steaklines and pathlines. **(10)**

(b) Define flow nets. Mention some important characteristics of conventional flow nets. **(10)**

(c) Given the function $\psi = 4xy$, determine the flow pattern. Show that the flow is irrotational and determine the ϕ-function. **(15)**

7. (a) State and prove Blasius's theorem. **(20)**

(b) Following Blasius's theorem for two dimensional flow past a profile of any cross section, with circulation, show that the drag force is zero and the lift force is $-\rho U \Gamma$. **(15)**

8. (a) Derive Karman-Prandtl equations for velocity distribution in turbulent flow past smooth and rough boundaries. **(20)**

(b) Water at 70°F flows past a smooth plane surface. Near a point on the surface several feet from the leading edge the velocities at 0.25 inch from the wall are 6.0 ft/sec and 6.5 ft/sec respectively. Assuming boundary layer is turbulent, determine and estimate the velocity one inch from the wall. **(15)**

L-2/T-2/NAME **Date: 16/03/2019**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2017-2018

Sub: **MATH 283** (Statistics, Partial differential Equation and Matrices)

Full Marks: 210 Time: 3 Hours

The figures in the margin indicate full marks

Symbols have their usual meaning.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) Form a partial differential equation by eliminating the function f from $z = xy + f(x^2 + y^2)$. **(11)**

(b) Find the general solution of the differential equation **(12)**

$$x^2 \frac{\partial z}{\partial x} - y^2 \frac{\partial z}{\partial y} = (x + y)z$$

(c) Find the complete integral by using Charpit's method: **(12)**

$$z = px + qy + p^2 + pq + q^2.$$

2. (a) State Lagrange's method. Solve the following: **(11)**

$$\left(D_x^2 + 5D_xD_y + 6D_y^2\right)z = \sin(x + 2y)$$

(b) Solve: $r - s + 2q - z = x^2y^2$. **(12)**

(c) Solve: $x^2 \frac{\partial^2 z}{\partial x^2} - y^2 \frac{\partial^2 z}{\partial y^2} = x^2 y$. **(12)**

3. (a) Determine whether the following system of linear equations is consistent or not. Hence solve it: **(15)**

$$\begin{aligned} 2x + y - 2z - 2w &= -2 \\ -x + 2y - 4z + w &= 1 \\ x - y + 2z - w &= -1 \end{aligned}$$

(b) Let $\begin{bmatrix} a & 0 & b & 2 \\ a & a & 4 & 4 \\ 0 & a & 2 & b \end{bmatrix}$ be the augmented matrix for a linear system. Find for what values of a and b the system has **(20)**

(i) a unique solution.

(ii) a one-parameter solution.

(iii) a two-parameter solution.

(iv) no solution.

Contd P/2

4. (a) Define canonical and normal form of a matrix. For the matrix $A = \begin{bmatrix} 1 & -2 & 1 & 3 \\ 4 & -1 & 5 & 8 \\ 2 & 3 & 3 & 2 \end{bmatrix}$, find non-singular matrice P and Q such that PAQ is in the normal form B. **(15)**

(b) Find the Eigenvalues, Eigenvectors and the corresponding Eigen spaces of the matrix $A = \begin{bmatrix} 0 & -1 & 0 \\ 0 & 0 & -1 \\ 1 & 3 & 3 \end{bmatrix}$. **(20)**

Determine whether the matrix A is diagonalizable or not. If possible, find $P^{-1}AP$.

SECTION – B

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) State and verify Cayley-Hamilton theorem for $A = \begin{bmatrix} 1 & 2 & 0 \\ 2 & -1 & 0 \\ 0 & 0 & -1 \end{bmatrix}$ and hence find A^{-2}. **(20)**

(b) Reduce the quadratic form $q = x_1^2 + 2x_2^2 + 2x_3^2 - 2x_1x_2 - 2x_2x_3 + x_3x_1$ to the canonical form and hence find its rank, signature and index of the form. **(15)**

6. (a) Lives of two models of refrigerators in a recent survey are: **(17)**

Life (No. of years)	Number of Model A	Refrigerators Model B
0–2	5	2
2–4	16	7
4–6	13	12
6–8	7	19
8–10	5	9
10–12	4	1

What is the average life of each model of these refrigerators? Which model has greater uniformity?

(b) Calculate coefficient of skewness by Karl Pearson's method and find the values of β_1 and β_2 and hence comment on your result for the following data: **(18)**

Profits (Tk. lakhs)	10–20	20–30	30–40	40–50	50–60
No. of companies	18	20	30	22	10

MATH 283/NAME

7. (a) A bag contains 6 red and 3 green balls. Four balls are successively drawn out and not replaced. What is the probability that they are alternatively of different colour? **(9)**

(b) Fit a Binomial distribution to the following data: **(9)**

X:	0	1	2	3	4
f:	28	62	46	10	4

(c) The following table gives the number of days in a 50 day period during which automobile accidents in certain part of a city. Fit a Poisson distribution to the data: **(11)**

No. of accidents:	0	1	2	3	4
No. of days:	19	18	8	4	1

(d) Show that there is some inconsistency in the statement given below: **(6)**

The mean of a Poisson distribution is 16 and its standard deviation is 9.

8. (a) The wages of 10 workers taken at random from a factory are given below: **(13)**

Wages (Tk.): 578, 572, 570, 568, 572, 578, 570, 572, 596, 584

Is it possible that the mean wage of all workers of this factory is Tk. 580? (Given that for $\nu = 9$, $t_{0.05} = 2.26$)

(b) The following table gives the number of good and bad parts produced by each of the three shifts in a factory. **(16)**

Shifts	Good	Bad	Total
Day	900	130	1030
Evening	700	170	870
Night	400	200	600
Total	2000	500	2500

Is there any association between the shift and the quality of parts produced? (Given that $\nu = 2$, $\chi^2_{0.05} = 5.991$)

(c) Write down some properties of normal distribution. **(6)**
