L-4/T-1/NAME **Date : 16/07/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **NAME 419** (Motion and Control)

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**.

Symbols have usual meanings.

1. (a) How is the group velocity of wave defined and how does it relate to the phase velocity in deep and shallow water? **(10)**

   (b) Show that in deep water, the wavelength, λ, in meter of a wave with period T secs is $1.56\,T^2$. **(5)**

   (c) Derive the expression for frequency of encounter, ω_e, when a vessel is travelling at an encounter angle of μ and a speed of V. From the derived expression, explain the following phenomena with typical examples: **(20)**

   (i) When the ship remains in the same position relative to the wave profile.

   (ii) When the ship overtakes the waves.

   (iii) The wave approach the ship from the aft.

2. (a) With a neat geometry, show all the dimensions of a typical all-movable control surface and also express different components of forces and moments in non-dimensional form of a rudder section shape experiencing ambient stream velocity U at an angle of attack α. **(15)**

   (b) What are the eight linear hydrodynamic derivatives that arise in the study of ship maneuvering? Discuss their relative magnitudes with sketches of relationship and justification of signs. **(20)**

3. (a) From the equation of motion of sway and yaw with rudder working, determine the equation of motion at the third or steady phase of the turn of a ship and hence find the expression for steady turning radius assuming x_g is at the origin. **(15)**

   (b) For a ship of L = 110 m, B = 18 m, T = 4.1 m, C_B = 0.68, the hydrodynamic and rudder derivatives are as follows: **(20)**

   $Y'_v = -9.65 \times 10^{-3}$; $Y'_r = 2.14 \times 10^{-3}$

   $N'_v = -2.57 \times 10^{-3}$; $N'_r = -1.44 \times 10^{-3}$

   $Y'_\partial = -1.0 \times 10^{-3}$; $N'_\partial = 0.5 \times 10^{-3}$

   Find its turning radius and drift angle for 16 knots at 35 degree rudder angle. Symbols have usual meanings.

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4. (a) Two designs possess the following values of derivatives" **(20)**

Design	Y'_v	N'_v	Y'_r	N'_r	m'
Design A	–0.36	–0.07	0.06	–0.07	0.12
Design B	–0.26	–0.10	0.01	–0.03	0.10

Comment on the straight line stability of the two designs. Assuming both design are 100 m long, how far are the neutral points forward of the centres of gravity?

(b) What is the purpose of zigzag maneuver? Draw a schematic diagram of a 20°/20° zigzag maneuver and define all the terms associated with it. **(15)**

SECTION – B

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

Assume reasonable value for any missing data.

5. (a) Show that, if the linear dimensions of a ship and those of its geometrically similar model are in the ratio of λ (the scale factor), the natural heaving period of ship is $\sqrt{\lambda}$ times that of model. **(10)**

(b) A ship has the following information

$L = 450$ ft, $B = 70$ ft, $C_{\omega p} = 0.80$, $\Delta = 12{,}500$ tons, $\omega_e = 1.18$ rad/sec, $\rho = 1.99$ lb-sec^2/ft^4, $\zeta_a = 10$ ft (wave amplitude). **(25)**

The added mass for heaving is 80% of the actual ship mass. The co-efficient for damping is given in non-dimensional form as $b\sqrt{gL/\Delta} = 1.70$. The amplitude of exciting force is also given in non-dimensional form as $f_0 = {F_0}/{\rho g \zeta_a LB} = 0.17$. Determine the heaving amplitude of the ship. Symbols have their usual meaning.

6. A ship has a radius of gyration of 30.80 ft, $GM_T = 4.84$ ft, $\Delta = 15{,}000$ tons. If the co-efficient of the roll damping moment expression [where damping moment = $b\left(\frac{d\phi}{dt}\right)$] has a value of 32,000 ft-ton-sec while the ship rolling in still water, calculate the amplitude for roll after three complete oscillations if the ship initially inclined at 7°. The added mass moment of inertia is 20% of that of the ship in this case of rolling. Also calculate the amplitude after two complete oscillations. Give reasons for difference of amplitudes. Symbols have their usual meaning. **(35)**

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7. (a) A ship has a rolling period of 15 sec, speed 35 knots approaching wave length of 900 ft. Determine the heading of the ship relative to the waves when the largest rolling period would be expected. How the rolling motion of a ship can be reduced? Explain. **(20)**

   (b) Using the ITTC wave spectrum formula, plot a wave spectrum for a wind speed of 31 knots and significant wave height 18.5 ft. **(15)**

8. (a) A ship has the following information: **(25)**

   L = 400 ft, T = 25 ft, V_s = 20 knots, L_ω = 628 ft h_ω = 20 ft, μ = 180° (i.e., head sea)

   Determine whether or not the forefoot of the ship emerges. Explain when the bow/forefoot will not emerge? Symbols have their usual meaning.

   (b) Describe the steps for determination of ship motion in an irregular seaway. **(10)**

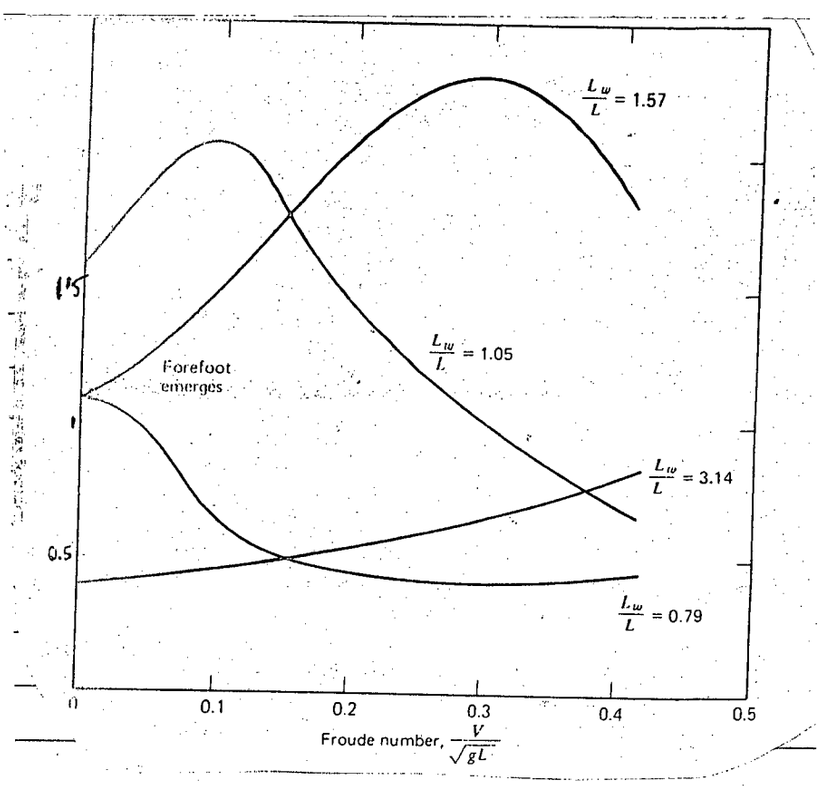

Fig. for Q. No. 8(a)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **NAME 415** (Marine Maintenance and Repair)

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**.

1. (a) Briefly describe the methods used for the built-up welding of shafts. **(12)**

   (b) What are the advantages and disadvantages of using galvanic coatings in ship repairing? Describe the principal measures taken in galvanizing shops to protect the health of the workers. **(15)**

   (c) When repairing the hull, boilers, or tanks, how butt-welding is carried out for the replacement of parts? **(8)**

2. (a) Describe the straightening procedure of shafts and shaft-like components in a ship when the deformations are small. **(10)**

   (b) How the cast iron components in ship structure are repaired by means of tie inserts? **(10)**

   (c) Discuss the methods of measuring misalignment of the shafts. **(15)**

3. (a) Describe a procedure for elimination of leaks in shall plating. **(10)**

   (b) Briefly describe a procedure for repair and replacement of double-bottom framing of ship hulls. **(13)**

   (c) Discuss the replacement and straightening procedures of frames, beams, bulkheads, stringers and other members of a ship. **(12)**

4. (a) List the principle types of damages found in propeller. How can you repair the corroded and eroded propeller? **(10)**

   (b) Schematically describe the straightening of deformed propeller blades. **(10)**

   (c) If a propeller has a peripheral velocity of 5 ms^{-1} irrespective of L/D, which method of balancing is used? Describe the method schematically. **(15)**

Contd P/2

NAME 415

SECTION – B

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

Assume suitable value for any missing data.

5. (a) A ship named "Ocean Queen" has been built in 2005 and since then did not encounter any collision or grounding in her voyages. But the record book showed that every time she came back in dry dock for surveying, some sort of damages were found and recommended to repair. In such cases, what do you think about the probable causes of the damages? Briefly explain. **(15)**

   (b) "The technology of ship repairing is a field in which micrometry is, by and large, the principal method of wear assessment" – justify this statement by comparing the applicability of various methods to determine the magnitude of wear. **(20)**

6. (a) How the contact continuity tests are carried out for fixed and movable joints? **(8)**

   (b) What is fouling? Briefly discuss the factors affecting fouling. **(12)**

   (c) How would you choose among the available anti-fouling paints based on their performance, cost and environmental impacts? **(15)**

7. (a) Describe the docking of ships in slip docks with a simplified diagram. How does a slip dock differ from a slip berth? **(20)**

   (b) What type of damages are revealed by underwater inspection? Why jobs like underwater welding and cutting are dangerous? **(15)**

8. A ship has been damaged severely at Chittagong port due to collision with another vessel. The particulars of damage are: **(35)**

   (i) damage of external shell plate (2 m × 2 m) of 11 mm thickness with single curvature 20 m aft of amidship.

   (ii) damage at the midship section includes shell plate flat vertical (3.2 m × 3.2 m) of 11 mm thickness, bottom shell of 3 m × 2 m of 11 mm thickness with single curvature.

   (iii) damage of keel plate (6 m × 2 m) of 11 mm thickness with double curvature.

   (iv) damage of deck plate (6 m × 2 m) of 11 mm thickness with single curvature.

   (v) damage of bilge strake (6 m × 1.6 m) of 11 mm thickness with double curvature.

   (vi) damage of internal bulkhead (10 m × 10 m) of 8 mm thickness.

   Determine the amount of steel required and man-hour required for steel works renewal.

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Table for Q No. 8

Table 8.1 Steel works renewals

Plate thickness (mm)	*Man-hours per tonne*
Up to 6	250
8	245
10	240
12.5	230
16	220
18	210
20	200

Correction for curvature	*Factor increase*
Single	1.2
Double	1.3

*Correction for location – **external***	*Factor increase*
Flat vertical side above 2 metres in height and requiring staging for access	1.1
Bottom shell, accessible areas (i.e. no removals of keel blocks)	1.12
Keel plate	1.4
Garboard plate	1.25
Bilge strake	1.25
Deck plating	1.15

*Correction for location – **internal***	*Factor increase*
Bulkhead	1.2
Longitudinal/transverse above DB areas	1.25
Longitudinal/transverse below DB areas	1.35

L-4/T-1/NAME **Date : 26/07/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **NAME 451** (Advanced Ship Structures)

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**.

In case of missing data, assume reasonable value. The symbols have their usual meaning.

1. (a) Write down the Westergaard function for a centre crack in an infinite plate subjected to a bi-axial stress field and show that the function satisfies the boundary conditions. **(15)**

   (b) Derive the stress field expressions for a general point near the crack tip for isotropic and linear elastic material in an infinite flat plate subjected to a bi-axial stress field for Mode 1 case. **(20)**

2. (a) Why should we evaluate stress intensity factor for a crack in a component? How does it help a designer? **(7)**

   (b) Determine the fracture and collapse stresses in a double-edge crack for a panel shown in Figure for Q. No. 2(b), assuming a/w = 0.4, panel width 2w = 8 in., and plane-strain fracture toughness of 65 ksi $(in)^{1/2}$. The yield strength of the panel material is 36 ksi. **(15)**

   (c) From Paris Law, derive the expression of crack propagation life. **(5)**

   (d) What are the major factors which influence environment assisted fracture? **(8)**

3. (a) Derive Smith-Southwell formula for strut with eccentric load. **(15)**

   (b) A steel strut is built up of two T-sections joined back to back to form a cruciform section of overall dimensions 150 mm × 220 mm. The dimensions of each T-section are 150 mm × 15 mm × 110 mm high. The ends of the strut are rigidly secured and its effective length is 7 m. Find the maximum safe load that this strut can carry with a factor of safety of 5, given $\sigma_y = 315$ MN/m^2 and a = 1/30000 in the Rankine-Gordon formula. **(20)**

4. (a) Derive the consistent mass matrix expressions for a plane truss element and a beam element. **(20)**

   (b) Find the natural frequencies of the stepped bar shown in Figure for Q. No. 4(b) by FEM. Use following data: $A_1 = 2$ in^2, $A_2 = 1$ in^2, $E = 30 \times 10^6$ psi, $\rho = 0.283$ lb/in^3 and $l_1 = l_2 = 50$ in. Use lumped mass matrix. **(15)**

Contd P/2

NAME 451

SECTION – B

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

Assume suitable values for any missing data. Symbols have their usual meaning.

5. (a) State what you understand by vibration neutralizer with the help of a simple diagram. For such a system derive the expressions of magnification factors of main mass and vibration neutralizer. Hence justify the following statements: **(25)**

   (i) When frequency of main structure and neutralizer are equal to the frequency of impressed force, the main structure comes to rest.

   (ii) When the frequency of the main structure id equal to the frequency of the exciting force but not equal to that of the vibration neutralizer, the magnification factor of the main structure may have a finite value.

   (b) A simply supported beam of square cross-section 5 mm × 5 mm and length 1 m, carrying a mass of 2.3 kg at the middle, is found to have a natural frequency of transverse vibration of 30 rad/s. Determine the Yaung's modulus of elasticity of the beam. (Assume spring constant $= \frac{192\ EI}{l^3}$). Hence comment on the material of the beam. **(10)**

6. Derive and analyze the response of an undamped system under harmonic force. Hence discuss the beating phenomenon. **(35)**

7. (a) Find the natural frequency and mode shapes of the system shown in Fig for Q. No. 7(a) with $m_1 = m_3 = m$, $m_2 = 2m$, $k_1 = k_2 = k$ and $k_3 = 2k$. **(22)**

   (b) Derive the equations of motion using Newton's second law of motion for the system shown in Fig. for Q. No. 7(b). **(13)**

8. (a) Determine the response of a spring mass damper system subject a periodic force with the equation of motion given by: **(20)**

$$m\ddot{x} + c\dot{x} + kx = \frac{a_0}{2} + \sum_{j=1}^{\infty} a_j \cos j\omega t + \sum_{j=1}^{\infty} b_j \sin j\omega t$$

   and comment on it.

   (b) What do you mean by equivalent mass? Discuss the concept of equivalent mass for the following cases. The relevant assembly is shown in Fig. for Q. No. 8(b)(i) and 8(b)(ii). **(15)**

   (i) Translational mass connected by a rigid bar

   (ii) Translation and rotational mass coupled together.

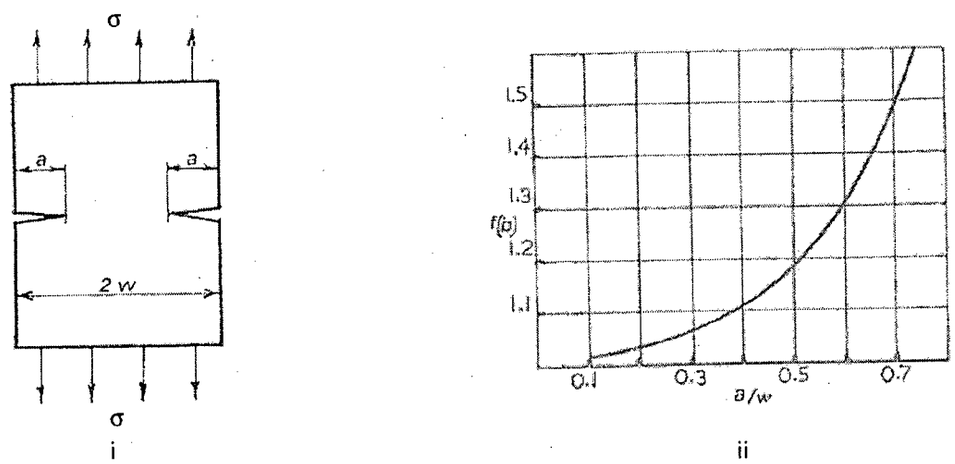

Figure for Q. No. 2 (b)

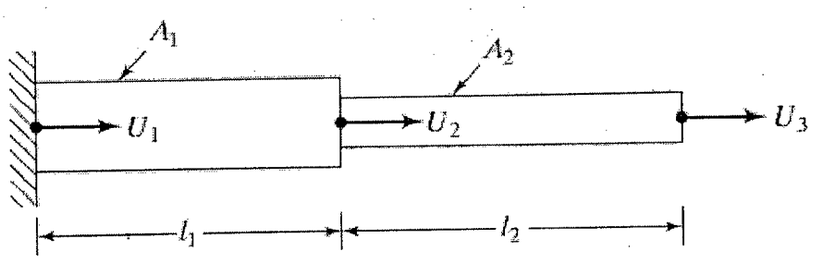

Figure for Q. No. 4(b)

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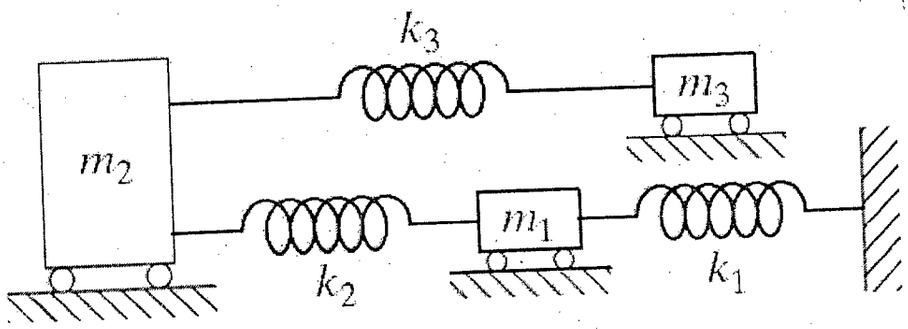

figure for question no. 7(a)

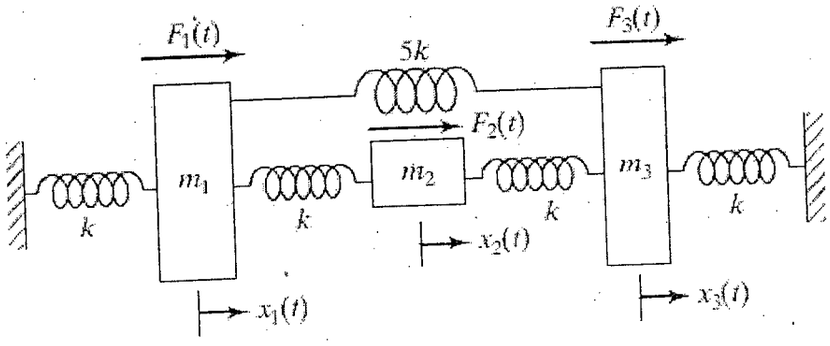

figure for question no. 7(b)

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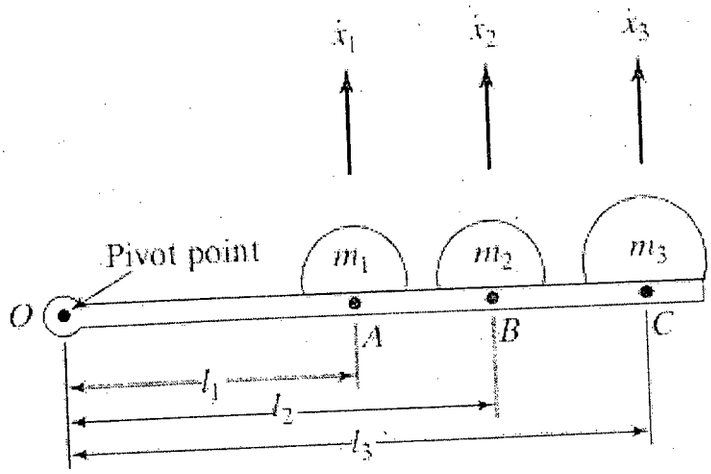

figure for question 8(b)(i).

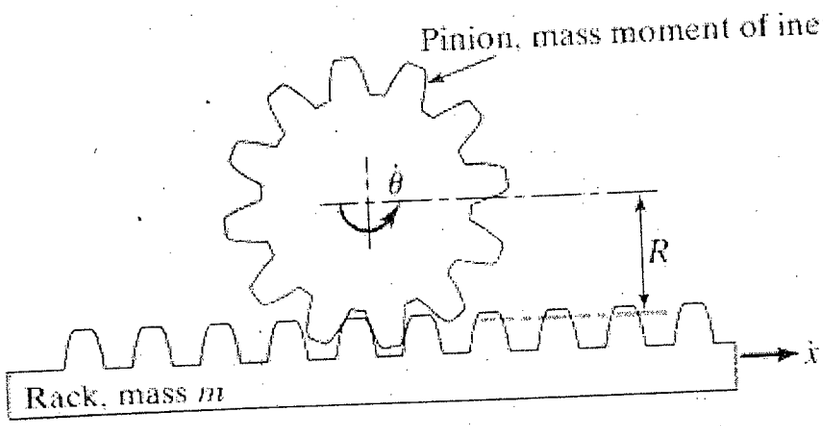

figure for question 8(b)(ii)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **NAME 477** (Optimization Methods in Ship Design)

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**.

1. (a) Differentiate between Genetic Algorithm and traditional methods of optimization. **(7)**

   (b) Develop metropolis criterion of simulated annealing method. Explain the physical basis of this method. **(8)**

   (c) Find the maximum of the function: $f(x) = -x^2 + 2x + 11$; in the range $-2 \le x \le 2$, using particle Swarm Optimization method. Use 4 particles with the initial positions $x_1 = -1.5$, $x_2 = 0.0$, $x_3 = 0.5$ and $x_4 = 1.25$. Show the detailed computations for iterations 1 and 2. **(20)**

2. (a) Derive the Karush-Kuhn-Tucker (KKT) conditions for the following problem: **(10)**

   Maximize $z = f(x)$

   subject to $g(x) \ge 0$

   (b) Consider the problem **(15)**

   Minimize $z = f(X)$

   subject to $g(X) = 0$

   where, $X = (x_1, x_2, \ldots\ldots x_n)$

   $g = (g_1, g_2, \ldots\ldots g_n)$

   Derive the constrained gradient vector of f with respect to z.

   (c) Discuss "Sensitivity Analysis in the Jacobian Method" of constrained optimization problem with equality constraints. **(10)**

3. Develop a model for Sequential Quadratic Programming (SQP) method. Solve the following problem using SQP method: **(35)**

   Maximize $z = 4x_1 + 6x_2 - 2x_1^2 - 2x_1x2 - 2x_2^2$

   subject to $x_1 + 2x_2 \le 2$

   $x_1, x_2 \ge 0$

Contd P/2

NAME 477

4. Solve the following function using Steepest Accent Method. (up to four iteration). **(35)**

   Maximize $f(x, y) = 4x + 6y - 2x^2 - 2xy - 2y^2$

   starting point $(x, y) = (1, 1)$

   and compare it with analytical solution.

SECTION – B

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

Assume suitable data/assumption if missing.

5. Express the following LP model in standard form **(35)**

   Maximize $z = 2x_1 + 3x_2 + 5x_3$

   subject to $x_1 + x_2 - x_3 \geq -5$

   $-6x_1 + 7x_2 - 9x_3 \leq 4$

   $x_1 + x_2 + 4x_3 = 10$

   $x_1, x_2 \geq 0$

   x_3 unrestricted.

6. Draw the typical flow chart for finding the optimal solution by the simplex algorithm and describe the process. **(35)**

7. What is ILP? Consider the following ILP: **(35)**

   Maximize $z = 5x_1 + 4x_2$

   subject to

   $x_1 + x_2 \leq 5$

   $10x_1 + 6x_2 \leq 45$

   $x_1, x_2 \geq 0$ and integer.

8. Why sensitivity analysis is required in solving LP problems. How are they done? Define Dual problem. Describe the mathematical details of dual problem with examples. **(35)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **NAME 413** (Theory of Hydrofoils)

Full Marks : 210 Time : 3 Hours

The figures in the margin indicate full marks.

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) Combining NACA Mean line a = 0.8 and NACA A010 Basic Thickness form (data provided in table below), draw the hydrofoil section on graph paper. **(20)**

x (% chord from L.E.)	y (= t (x)/2) (% chord)	Y_c (= f(x)) (% chord)	$\frac{dY_c}{dx}$
0	0.0	0.0	---
5	2.182	1.841	0.2772
10	3.040	3.043	0.2105
30	4.742	5.863	0.0878
50	4.863	6.790	0.0062
80	2.352	4.771	–0.1841
90	1.188	2.435	–0.2558
100	0.021	0.0	–0.2039

(b) A circle passes through x = a = 1 m and the center of the cicle is located at x_c = –0.2 m and y_c = 0.3 m. The uniform free stream velocity is U = 3 m/s and is inclined at an angle $\alpha = 10°$. **(15)**

Calculate the velocity components u and v in the x and y direction at the position x = 1.5 m and y = 2 m for circulation strength zero around the circle.

2. A hydrofoil section comprises NACA a = 0.8 meanline and NACA 66 (modified) thickness form. **(35)**

(i) Calculate pressure distribution for 5.5% camber instead of 6.79% camber for which the $\Delta v/V$ values are given. The required lift coefficient, C_L = 0.9.

(ii) Compare the predicted lift coefficient. The relevant velocity data is provided below:

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NAME 413

Contd ... Q. No. 2

	% chord from L.E.	v/V (for NACA 66 (mod.) thickness form	$\Delta v_a/V$ (for incidence corresponding to $C_L = 1.0$ and NACA 66 (mod.) thickness	$\Delta v/V$ (for NACA a = 0.8 meanline and corresponding $C_{Li} = 1.0$)
1	0	0.0	2.987	0.278
2	5	1.071	0.679	0.278
3	10	1.093	0.478	0.278
4	20	1.111	0.323	0.278
5	30	1.121	0.249	0.278
6	40	1.128	0.198	0.278
7	50	1.127	0.161	0.278
8	60	1.099	0.127	0.278
9	70	1.064	0.097	0.278
10	80	1.023	0.071	0.278
11	90	0.974	0.045	0.139
12	95	0.945	0.029	0.069
13	100	0.0	0.0	0.0

3. Prove, **(35)**

$$\delta v = \frac{\Gamma}{4\pi R^2} . \sin\theta . \delta s$$

for induced velocity at a point in the field of an elementary length δs of vortex of strength Γ.

4. (a) Define bound vortex system, starting vortex and the trailing vortex system related to lifting wing. **(10)**

(b) With figure define horseshoe vortex. **(10)**

(c) Prove the following relations with figure: **(5×3=15)**

(i) $v = \frac{\Gamma}{4\pi h}(\cos\alpha + 1)$

for a linear vortex of semi-infinite length.

(ii) $v = \frac{\Gamma}{4\pi h}$

for a linear vortex of semi-infinite length.

(iii) $v = \frac{\Gamma}{2\pi h}$

for a linear vortex of infinite length.

Contd P/3

NAME 413

SECTION – B

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

Assume suitable value for any missing data.

5. (a) Explain Kutta-Zhukovsky transformation. **(15)**

   (b) Describe the method for transformation of a circle into a cambered hydrofoil. **(20)**

6. (a) Derive the expression of downwash for a finite span hydrofoil with a simple symmetric loading. **(15)**

   (b) Describe thin hydrofoil theory. **(5)**

   (c) A hydrofoil has span of 3.2 m and aspect ratio 6.3. For elliptic loading the maximum circulation is 0.83 m^2/s. Calculate lift, vortex induced drag, lift coefficient and vortex induced drag coefficient considering flow velocity of 9.5 m/s. **(15)**

7. A thin hydrofoil has a camber line defined by $y = k_x (x - 1) (x - 3)$ where x and y are the coordinates expressed in terms of unit chord and the origin is at the trailing edge. If the maximum camber is 3.6% of the chord, calculate the lift coefficient at 7° angle of incidence. **(35)**

8. (a) Write short notes on:

   (i) Spanwise loading and trailing vorticity of a finite hydrofoil. **(15)**

   (ii) Downwash for elliptic distribution **(10)**

   (b) What are the influences of downwash on hydrofoil velocities and forces? **(10)**

L-4/T-1/NAME **Date : 31/07/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **NAME 475** (Dredger and Dredging Technology)

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 **Q. No. 4** and any **TWO** from the rest. Symbols have their usual meaning. Assume reasonable value in case of any missing data.

1. (a) Define dredging. Explain the term: Capital dredging, Maintenance dredging, Anti-entrophication and Beach nourishment. **(10)**

   (b) Mention the factors you should consider for selecting dredging equipment for any project. **(5)**

   (c) Classify Mechanical, Hydraulic and Pneumatic Dredgers in a Tabular form considering individual type, method of extraction, method of transportation and method of disposal. **(20)**

2. (a) Give a brief description of physical mechanism involved in the dredging process. **(23)**

   (b) Mention the salient features of Centrifugal Dredge Pump. Schematically show the comparison of performance curves between a centrifugal pump pumping slurry and a centrifugal pump pumping clear water. **(12)**

3. (a) Write short notes on **(20)**

   (i) dredging need in Bangladesh

   (ii) site investigation for dredging project

   (b) A heavy duty slurry pump is required for the following duty: **(10)**

   designed flow rate for slurry = 1.68 ft^3/sec

   specific gravity of sand particle = 2.65

   Average particle size d_{50} = 211 microns

   Carrier fluid specific gravity (water) = 1.0

   C_v = 13.9%

   A designer has recommended 6″ delivery pipeline for this arrangement. Is this size of pipe suitable? Justify your answer by supporting calculation.

   (c) Mention possible impacts to environment due to dredging activity for a project. **(5)**

Contd P/2

NAME 475

4. (a) A dredged pump centerline is located 2 ft below the water level. The cutter head dredger is operating in 15 ft of water and has a 30 ft suction pipe and 200 ft discharge pipe and each pipe has a diameter of 4 inch. The channel bottom material is sand (median diameter of sand = 0.08″) and water has specific gravity 1.0 and average temperature 70°F. The other available data are! **(25)**

desired concentration C_w = 40% by weight

estimated terminal settling velocity V_s = 0.95 ft/sec

estimates drag co-efficient C_D = 0.4

For delivery of 0.363 cubic ft of sand per second, determine:

(i) Limiting deposit velocity

(ii) Transition velocities for different regimes of flow

(iii) Head loss per unit length of pipeline.

(iv) Friction head loss neglecting minor losses.

Assume F_L = 1.3 and f = 0.0142

(b) Suppose dredge material of Q. No. 4(a) has to be delivered to a construction site through a 500 ft floating pipeline and of an onshore pipeline. What could be possible minor losses for this case? Why is it important for fixing power of dredge pump? Explain. **(10)**

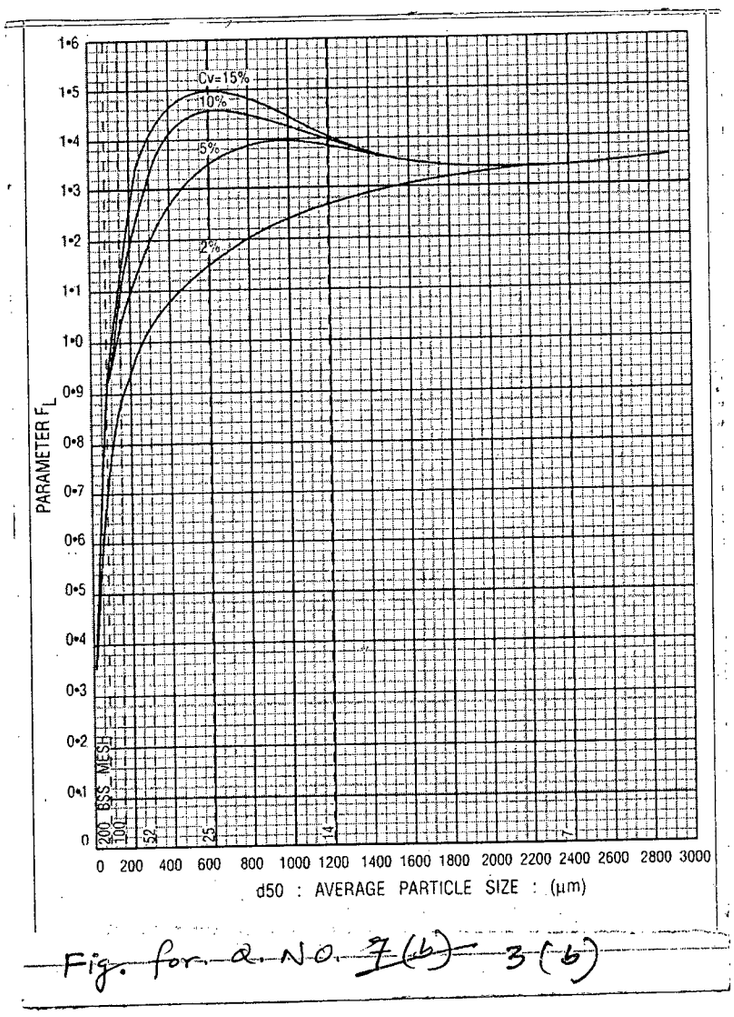

Fig. for Q. No. 4(b) — 3(b)

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SECTION – B

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

5. (a) Consider that sand particles occupy 27% of the total volume of a dredging pipeline. The rest is occupied by carrying water. The sand-water mixture is discharged from the dredging pipeline at a deposit site. The porosity of the sand in the deposit site is 0.4. Determine the density of sand-water mixture in the pipeline, the weight concentration of solids in the mixture and the in situ density of sand in the deposit site. **(10)**

   (b) Briefly discuss the influence of the following design criteria while designing a cutter suction dredger (CSD): **(15)**

   (i) Dredging depth

   (ii) Type of soil

   and (iii) Production capacity

   (c) With a neat sketch show the production cycle for a grab hopper dredger. **(10)**

6. (a) Explain the importance of spud system in a CSD. Briefly describe the spud carriage system used in a CSD. **(15)**

   (b) What are the functions of over flow system in a Trailing Sunction Hopper Dredger (TSHD). Briefly discuss various over flow systems used in TSHD. **(10)**

   (c) What are the requirements for tooth system and cutting edge system in a CSD. Name various types of tooth and cutting edge used in CSD. **(10)**

7. (a) Distinguish between the followings: **(15)**

   (i) Drag head and cutting head

   (ii) Delay factor and operational factor

   and (iii) Shore pipeline and floating pipeline

   (b) With neat sketches describe hopper loading systems in a TSHD. **(10)**

   (c) Discuss the working principle of a dustpan dredger. **(10)**

8. (a) What are the advantages and disadvantages of a CSD. **(10)**

   (b) With a neat sketch show main features of a TSHD. **(10)**

   (c) Write short notes on the followings: **(15)**

   (i) Anchor boom

   (ii) Dredge bucket

   (iii) Swell compensator

   and (iv) Bulking factor

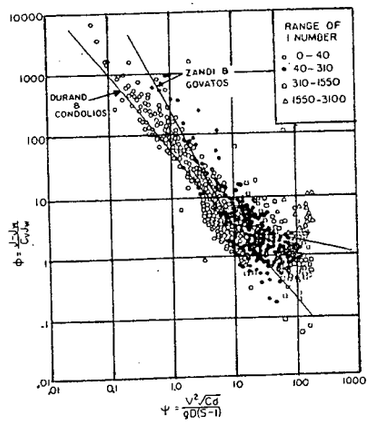

Figure 9.8. Head loss in heterogeneous flow—after Zandi and Govatos.

Table 9.5. Limiting Deposit Velocity for Particles Greater Than 1mm in Diameter (Ref. 12)

Pipe Diameter (d) (mm)	Limiting Deposit Velocity Sand m/sec	Coal m/sec
150	2.95	1.65
250	3.75	2.15
440	5.00	2.85
900	7.15	4.00

Durand and Condolios[25] presented an equation for flow based on test results as follows.

$$\frac{i_m - i}{C_v i} = 81\left[\frac{gd\,(\rho_s/\rho_w - 1)}{V^2}\left(\frac{1}{C_D}\right)\right]^{1.5} \qquad 9.19$$

Newitt et al.,[14] conducted an experiment in a smaller size pipe (1 inch) with several sediments ranging from plastics to gravel and manganese dioxide. They suggested the Equation 9.20 for heterogeneous flow.

$$(i_m - i)/(C_v i) = 1100\,[(\rho_s/\rho_w) - 1]\,(gd/V^2)\,(V_t/V) \qquad 9.20$$

where

V_t = particle settling velocity.

For saltation flow (for particle $d_{50} > 0.001$ in.)

$$(i_m - i)/(C_v i) = 66\,[(\rho_s/\rho_w) - 1]\,(gd/V^2) \qquad 9.21$$

The transition zone between homogeneous and heterogeneous regimes is given as

$$V_{th} = (1800\,gdV_t)^{1/3} \qquad 9.22$$

where

V_{th} = transition velocity from homogeneous to heterogeneous regime

Transition zone between heterogeneous and saltation region is given as

$$V_{ts} = 17\,V_t \qquad 9.23$$

where

V_{ts} = transition velocity from heterogeneous to saltation regime

Worster[8] presented the flow equations based on work by Turtle:

$$\frac{C_c - C_c'}{g} = 4\left(\frac{V_i}{V}\right)^{0.173}\frac{C_c}{\sqrt{g}}\left[\frac{C_v d\,g(\rho_s/\rho_w - 1)}{V^2}\right]^{0.413} - 4 \qquad 9.24$$

where

C_c = Chezy friction factor for water
C_c' = Chezy friction factor for mixture

which applies when

$$(C_c - C_c')/\ 1/\sqrt{g} < 13$$

Wilson[26] proposed an equation for friction head loss in feet of slurry based on data obtained on pumping molybdenum tailings in Colorado.

$$h_f' = L\left(\frac{fV^2}{2gd} + C_1\frac{C_w V_t}{V}\right) \qquad 9.25$$

where

f = Darcy Weisbach friction factor
C_1 = Constant

The velocity (in fps) which produces a minimum friction loss for given conditions is

$$(V_{hf})_{min} = C_2 \sqrt[3]{(C_w V_t g d)/f} \qquad 9.26$$

where

K_2 = constant

Wilson also presented Equation 9.27 which gives a guide as to whether particles are suspended in flowing water or whether they will settle to form a bed at the bottom of the pipe.

$$C_3 = \frac{V_t}{\sqrt{(h'_f g d)/4L}} \qquad 9.27$$

when $C_3 > 1$ most of the particles with terminal velocity (V_t), will stay in suspension and when $C_3 \leq 1$ most of the particles with terminal velocity (V_t) will settle out.

Zandi and Govatos[15] in an effort to separate experimental data for the heterogeneous regime from the saltation flow developed an Index Number (N_l)

$$N_l = \frac{V^2 \sqrt{C_d}}{C_v d g \left[(\rho_s - \rho_w)/\rho_w\right]} \qquad 9.28$$

The critical value of N_l indicates the separation of the two flow regimes, i.e.

$$(N_l)_{\text{critical}} = 40 \qquad 9.29$$

The saltation flow occurs for $N_l < 40$ and the heterogeneous regime for $N_l > 40$.

Babcock and Shaw using Blatch's data[27] concluded that N_l should be equal to ten for separation of the heterogeneous and moving bed regimes. Additional experimental verifications are required.

Modified Durand Equation (by Zandi)

Zandi analyzed Durand's data which were selected on the basis of the Index Number (N_l); only those data points which were in the heterogeneous regime were selected for analysis. Zandi points out that

$$N_l = \frac{1}{C_v}\left[\frac{V^2 \sqrt{C_d}}{g d \left(\frac{SG_s - SG_w}{SG_w}\right)}\right] = \frac{\psi}{C_v} \qquad 9.30$$

and

$$\phi = \frac{J - J_w}{C_v - J_w} = K(\psi)m \qquad 9.31$$

where both K and m are coefficients shown in Table 9.6. Durand's reanalyzed data are plotted in Figure 9.8 as ϕ versus ψ. Note that better correlation of all values of ψ is achieved if ψ is divided into two separate ranges, for $\psi > 10$ and for $\psi < 10$ as indicated in Table 9.6.

Table 9.6. Values of Coefficient K and m in Equation 9.31

Range of ψ	K	m
$10 < \psi$	6.3	−0.354
$\psi < 10$	280.0	−1.93

Blockage of Pipe

In some cases it may be desirable to design for solids transport in the moving bed regime or such flows may be the result of insufficient power. Many designs call for no settlement of sediment (heterogeneous regime) but under certain conditions it may be economically desirable to permit some settlement resulting in partial blockage of the cross sectional pipe area. The partial blockage occurs when the rate of sediment supply to the pipe exceeds the transporting capacity of the water. The sediment will deposit at the bottom of the pipe until an equilibrium condition is reached when the cross sectional area is sufficiently reduced to provide sufficient transporting capacity.

Craven[28] conducted studies in 2-inch and 5.5-inch diameter pipes, with three approximately uniform sands having median diameters of 0.25, 0.58 and 1.62 mm respectively, to determine blockage characteristics. He determined that for relatively high values of relative transport rate (Q_s/Q) Darcy's hydraulic gradient (i) was proportional to the two-thirds power of Q_s/Q, as shown in Equation **9.32**.

$$i = (dh/dx) = C_3 (Q_s/Q)^{2/3} \qquad 9.32$$

where

Q_s = absolute rate of sediment transport
C_3 = constant
= $1/1.65[(\gamma_s - \gamma_w)/\gamma_w)]$ for 0.58 and 1.62 mm sands
= $0.6/1.65[(\gamma_s - \gamma_w)/\gamma_w)]$ for 0.25 mm sand.

L-4/T-1/NAME **Date : 06/08/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-1 B. Sc. Engineering Examinations 2014-2015

Sub : **IPE 479** (Engineering Management)

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.

1. (a) Mention the advantages of exponential smoothing technique of forecasting. The demand of Product "H" is quite stable with time. Which quantitative method of forecasting do you suggest to use and why? **(5+7)**

   (b) A consumer goods manufacturing company sells its products through dealers and retailers. If the company wants to use a qualitative forecasting techniques, which method it should use and why? **(8)**

   (c) The exponential smoothed forecast including trend for the month of July was 10450 units. Trend effect for July was 420 units. But the actual demand turned out to be 10750 units. Calculate forecast including trend for the month of August ($\alpha = 0.50$, $\delta = 0.30$) **(15)**

2. (a) Briefly describe purposes of inventory. **(8)**

   (b) Explain advantages of fixed order quantity inventory models. **(5)**

   (c) A company uses quarterly demand forecast to develop its production plan. The company uses past demand data to predict the future demand. The actual sales of a product for the last 12 quarters are as follows: **(22)**

Year 2013	Sales	Year 2014	Sales	Year 2015	Sales
1st Quarter	1120	1st Quarter	1520	1st Quarter	2090
2nd Quarter	1330	2nd Quarter	1830	2nd Quarter	2260
3rd Quarter	1240	3rd Quarter	1780	3rd Quarter	2140
4th Quarter	1520	4th Quarter	2020	4th Quarter	2520

   Predict the demand of the product in each quarter of the year 2016 using linear regression technique.

3. (a) A retail company purchases Product "H" from one of its suppliers. The weekly demand of the product is 5000 units. The quarterly holding cost of the product is 1% of the cost per unit which is Tk. 650 per unit. It costs Tk. 75000 to carry out the activities for 3 ordering cycle. The supplier cannot deliver the entire order at one go. The production rate in the supplier's plant is around 1100 units per day. The supplier delivers the first lot after 5 days. Determine the re-order point and economic order quantity. **(15)**

Contd P/2

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Contd ... Q. No. 3

(b) Determine the project completion time, critical path, and slack time for each activity for the following information: **(20)**

Activity	Immediate Predecessor	Time (Weeks)
A	None	6
B	None	9
C	A, B	5
D	A, B	3
E	C	5
F	C	10
G	E, F	4
H	E, F	6
I	A, B	20
J	G, I	8
K	G, J	4
L	J,K	5
M	J, K	5
N	L, M	7
O.	L, M	3

4. (a) A manufacturing company is planning to replace an old machine with a new CNC machine. The related financial data are given below: **(18)**

Purchase price of the new machine = Tk. 90 lacs,

Installation and Employee training cost = Tk. 20 lacs,

Savings in annual maintenance cost = Tk. 0.50 lacs,

Increase in profit-From year 1 to 5: Tk. 12 lacs; From year 6 to 12: Tk. 18 lacs; From year 13 to 20: Tk. 15 lacs

Overhauling cost at the end of 10^{th} year = Tk. 5 lacs

Salvage value = Tk. 10 lacs

The company wants 10% return on its investment. Decide whether the company should purchase the new CNC machine.

(b) Define "Gantt Chart" and "Work Breakdown Chart". Mention advantages and disadvantages of the functional organization structure. **(6+6)**

(c) Mention sources of error in forecasting. **(5)**

Contd P/3

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SECTION – B

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

5. (a) Define management. Explain the four basic management functions. **(15)**

   (b) Mention the five bases of power with appropriate examples. **(10)**

   (c) How are different management levels associated with different managerial skills? Explain. **(10)**

6. (a) What are the 14 principles of management according to Henri Fayol? Explain any five of them. **(15)**

   (b) Show the decision making process in a neat flow chart. **(5)**

   (c) Explain the key elements of organizational design. **(15)**

7. (a) Explain the equity theory of motivation. **(15)**

   (b) Write short notes on the Hawthorne study. **(10)**

   (c) Mention the relative advantages and disadvantages of different performance appraisal methods. **(10)**

8. (a) Briefly explain some of the financial parameters that are used to compare multiple investment proposals. **(8)**

   (b) The estimated monthly demand of a product is 20000 units. The manufacturing plant will operate 16 hours per day and 6 days a week. The list of the process required and time required to complete each process are given below: **(18)**

Process	Immediate Predecessor	Time (Sec)
A	None	40
B	A	20
C	A	50
D	B	20
E	B, C	16
F	B, C	32
G	E, F	15
H	E, F	26
I	A, B	60
J	G, I	24
K	G, J	31
L	J, K	10

Determine the minimum number of workstations required, assign the processes to the workstations, and calculate the line efficiency.

(c) Why is necessary to balance a production line? Differentiate between "Project" and "Matrix" organization structure. **(4+5=9)**
