L-1/T-1/CE **Date : 08/08/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2015-2016

Sub : **MATH 137** (Differential and Integral Calculus, Matrices)

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) A function $f(x)$ is defined as follows $f(x)=\begin{cases} x^2+2, & x\le 1 \\ x+2, & x>1 \end{cases}$

Discuss the continuity and differentiability of $f(x)$ *at* $x=1$. Sketch the graph of $f(x)$. **(10)**

(b) Evaluate $\lim\limits_{x\to 0^+}\left(\frac{1}{x}-\frac{1}{\sin x}\right)$. **(10)**

(c) Expand $e^x \ln(1+x)$ in a series of ascending powers of x. **(15)**

2. (a) If V be a function of x and y, prove that $\frac{\partial^2 V}{\partial x^2}+\frac{\partial^2 V}{\partial y^2}=\frac{\partial^2 V}{\partial r^2}+\frac{1}{r}\frac{\partial V}{\partial r}+\frac{1}{r^2}\frac{\partial^2 V}{\partial \theta^2}$ **(18)**

where $x=r\cos\theta,\ y=r\sin\theta$.

(b) If $y=a\cos(\log x)+b\sin(\log x)$, then show that $x^2 y_{n+2}+(2n+1)xy_{n+1}+(n^2+1)y_n=0$ **(10)**

(c) Find the nth derivative of the following function $y=e^x \sin x \sin 2x$. **(7)**

3. (a) An open box is to be made from a 16-inch by 30-inch piece of cardboard by cutting out squares of equal size from the four corners and bending up the sides of the cardboard. What size should the squares be to obtain a box with the largest volume? **(15)**

(b) Prove that the curves $\frac{x^2}{a}+\frac{y^2}{b}=1$ and $\frac{x^2}{a'}+\frac{y^2}{b'}=1$ will cut orthogonally if **(10)**

$$a-b=a'-b'$$

(c) If $F(v^2-x^2,\ v^2-y^2,\ v^2-z^2)=0$, where v is a function of x, y and z. Show that **(10)**

$$\frac{1}{x}\frac{\partial v}{\partial x}+\frac{1}{y}\frac{\partial v}{\partial y}+\frac{1}{z}\frac{\partial v}{\partial z}=\frac{1}{v}$$

4. Find the following:

(i) $\int \frac{1}{\sqrt[3]{\sin^{11} x\cos x}}dx$ **(10)**

(ii) $\int \frac{1}{1-2\cos x+3\sin x}dx$ **(15)**

(iii) $\int e^x \frac{2-\sin 2x}{1-\cos 2x}dx$ **(10)**

MATH 137

SECTION – B

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

5. (a) Find the reduction formula for $\int cos^m x \cos nx \, dx$ and hence find $\int cos^3 x \cos 3x \, dx$. **(15)**

(b) Evaluate $\int_0^{\pi/2} \frac{dx}{5+3\cos x}$. **(10)**

(c) Evaluate $\int_0^{\pi/2} \frac{\sin^2 x}{1+\sin x \cos x} dx$ **(10)**

6. (a) Prove that $\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$. Also find $\int_0^{\infty} e^{-ax^2} dx$. **(15)**

(b) Evaluate $\int_0^1 x^m \left(1-x^n\right)^p dx$. **(10)**

(c) Evaluate $\iiint_R ye^x dxdydz$ **(10)**

Where R:: $0 \le x \le \ln y$, $1 \le y \le \sin z$, $0 \le z \le \pi$.

7. (a) Find the inverse of the following matrix using elementary column transformations. **(17)**

$$A = \begin{bmatrix} 1 & 2 & -2 & -1 \\ -1 & -4 & 4 & 0 \\ 2 & -7 & 4 & -7 \\ 1 & 6 & -5 & 1 \end{bmatrix}$$

(b) Solve the following system of equations using matrix

$$\begin{aligned} x_1 + x_2 + x_3 + x_4 &= 4 \\ 2x_1 - x_2 - x_3 + 3x_4 &= 6 \\ 3x_1 + 4x_2 - 5x_3 + 6x_4 &= -11 \\ 7x_1 - 5x_2 + 7x_3 + x_4 &= 46 \end{aligned}$$ **(18)**

8. (a) State Cayley-Hamilton theorem. Verify the theorem for the matrix **(17)**

$$A = \begin{bmatrix} 5 & 3 & -1 \\ 3 & 5 & -1 \\ -3 & -3 & 3 \end{bmatrix}$$

(b) Find all the eigenvalues and corresponding eigenvectors of the matrix **(18)**

$$A = \begin{bmatrix} 5 & -1 & 1 \\ -1 & 2 & -4 \\ 1 & -4 & 2 \end{bmatrix}$$

L-1/T-1/CE **Date : 18/07/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2015-2016

Sub : **CE 101** (Analytic Mechanics)

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) The cantilever frame shown in Fig. 1 consists of two horizontal members AC and DF, a vertical member BE and an inclined member CF. All the members have been assumed to be weightless. Calculate the components of pin reactions at A and force in the member CF. **(14)**

   (b) Derive an expression for the span length of a symmetrical catenary in terms of sag(d), tension at the low point (Q) and weight per foot (w) of the catenary. **(11)**

   (c) Determine the moment of inertia of the shaded area shown in Fig. 2 about the line y = 4 inch. **(10)**

2. (a) A table supports a load of 300 N at point D as shown in Fig. 3. The weight of the triangular top of the table is 200 N. Calculate the reactions at the supporting legs A, B and C. Given, AB = AC = 1200 mm and BC = 900 mm. **(12)**

   (b) The body A in Fig. 4 weighs 300 lb. The coefficients of static friction are 0.4 between the body and the inclined plane, and 0.25 between the rope and the drums. Determine the value of W when motion of the body A impends up the plane. **(12)**

   (c) A flexible cable weighing 3 lb/ft is strung between two supports. One support is 80 ft higher than the other and the sag measured from the upper support is 130 ft. The tension in the cable at the lower support is 9000 lb. Calculate the following: **(11)**

   (i) Distance between the two supports

   (ii) Total length of the cable

   (iii) Slope in degree at the upper support

   (iv) Tension at the upper support.

3. (a) A bar AB of weight 400 N is hinged to a wall at A and supported by a cable as shown in Fig. 5. The length of the bar AB is 10 m. Determine the tension in the cable and components of pin reactions at A and C. **(12)**

   (b) The body A weighing 400 N rests over the body B weighing 800 N as shown in Fig. 6, the coefficient of static friction between A and B is 0.3 and between B and the floor is 0.25. Calculate the value of the force P that will cause the body B the have impending motion toward right. **(11)**

Contd P/2

CE 101

Contd ... Q. No. 3

(c) A slender brass rod of uniform cross-section has been welded at the center of the base of a cast-iron cone as shown in Fig. 7. Weight of the rod and unit weight of cast-iron are 26 lb and 490 lb/ft^3, respectively. Calculate the radius of gyration of this composite mass with respect to z′ axis. **(12)**

4. (a) Using direct integration, determine the co-ordinates of the centroid of the area bounded by the parabola $y^2 = 4x$, the straight line $y = 6$ inch and the y-axis. **(10)**

(b) For the truss shown in Fig. 8, find the force in the members ac, cd, cf, eg and hi. **(13)**

(c) Two cables AC and BC terminate on a pole and exert forces in a horizontal plane x′y′ at C as shown in fig. 9. The tension in the cables AC and BC are 8000 lb and 7000 lb, respectively. The guy cable makes an angle of 40°with the pole. Calculate the value of the angle θ, tension in the cable CD and force in the pole CE. **(12)**

SECTION – B

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

5. (a) In Fig. 10, body A is suspended from a cable wound around a 5-ft drum. It is moving down with an initial velocity of 10 fps and a constant acceleration of 2 fps^2. When $t = 3$ second, determine the normal and tangential acceleration of point P on the flywheel, that turns with the drum. **(10)**

(b) A 4-ft cylinder, which weighs 644 lb., rolls down a plane as shown in Fig. 11. What will be the speed of its c.g. after it has rolled 50 ft from rest. Solve by using the principle of impulse and Momentum. **(13)**

(c) Find the **x** and **y** coordinates of the centroid of the shaded area shown in Fig. 12. **(12)**

6. (a) In Fig. 13. $\mathbf{W_B} = 100$ kg, $\mathbf{f_B} = 0.2$, $\mathbf{f_C} = \mathbf{f_D} = 0$ and $\theta = 30°$. The body A moves down 5 m from rest in 2 second. Determine the weight of A and the tension in the cable. Use Newton's Law. **(11)**

(b) In Fig 14, $\mathbf{W_A} = 1000$ lb. $\mathbf{f} = 1/3$, and the pulleys **C** and **D** are to be considered frictionless and weightless. If **A** moves 60 ft from rest up the incline in 12 seconds, determine the weight W_B and the force in the cable attached to **A**. Use the Principle of Impulse and Momentum. **(13)**

(c) A cylindrical drum is pulled by a force **P** as shown in Fig. 15. The drum weighs 1200 N. The coefficient of static friction for all surfaces is 0.5. Determine the magnitude of **P** when the drum just starts spinning. Given, $\theta = 75°$. **(11)**

Contd P/3

CE 101

7. (a) In Fig. 16, $\mathbf{W_A}$ = 64.4 lb, $\mathbf{f_k}$ = 0.2, θ =30°, $\mathbf{W_B}$ = 966 lb and **D** = 4 ft. The chord from **A** warps about the cylinder **B**. Find the velocity of **A**, 5 second after it is released from rest. Use the Principle of Work and Kinetic energy. **(12)**

   (b) The ore car **B**, in Fig. 17, weighs 15 tons. The counter weight **A** just resists the downward motion of **B**. If θ = 60° and the coefficient of friction between **B** and the plane is 0.25, determine the weight of **A**, by Virtual Work method. **(13)**

   (c) Derive an expression for the moment of inertia of a homogenous right circular cylinder about a diameter of its base. **(10)**

8. (a) In Fig. 18 bodies A and C are connected by a weightless flexible cord over a smooth surface **B** ($\mathbf{f_B}$ = 0), The coefficient of friction $\mathbf{f_A}$ = 1/3. If $\mathbf{W_A}$ = 64.4 lb, $\mathbf{W_C}$ = 96.6 lb and the initial velocity of **A** is 30 fps towards the left, find the time in seconds for **A** to travel 10 ft. Solve using the Principle of Work and Kinetic energy. **(13)**

   (b) Using the Principle of Virtual Work, determine the force in the bar **DE** of the truss structure shown Fig. 19. **(12)**

   (c) Determine the reactions at support A and B of the simply supported beam shown in Fig. 20. **(10)**

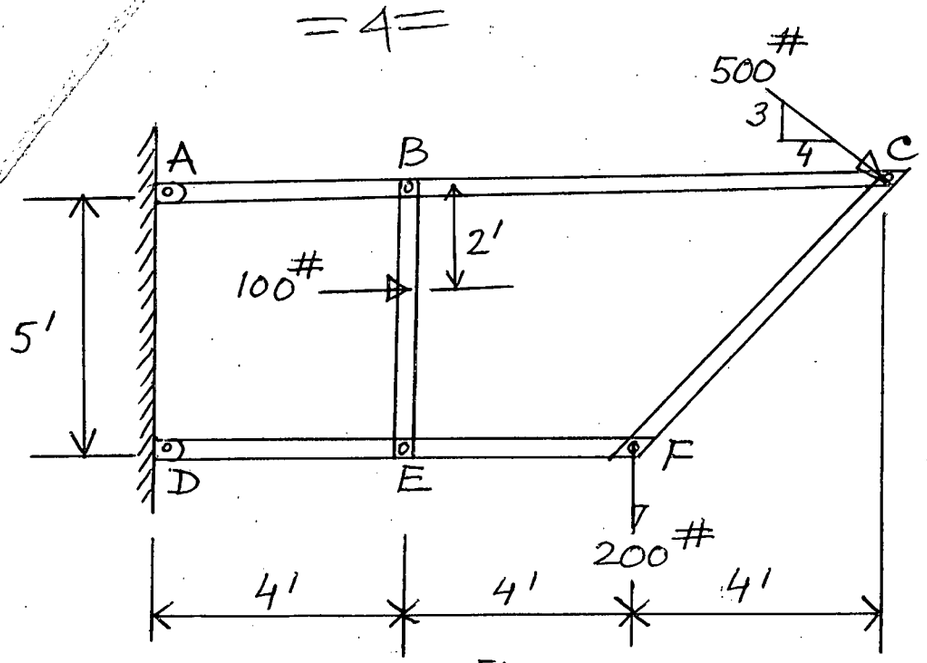

Fig. 1

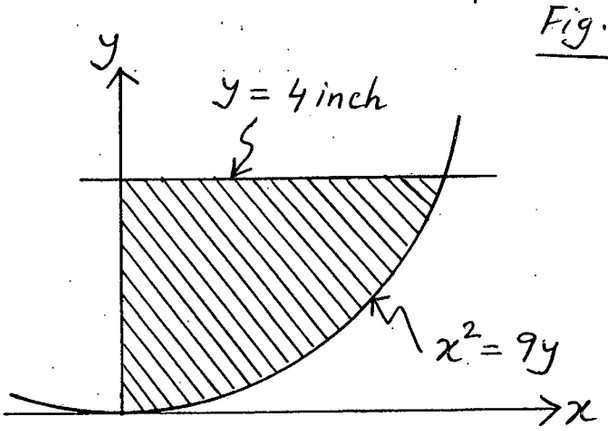

Fig. 2

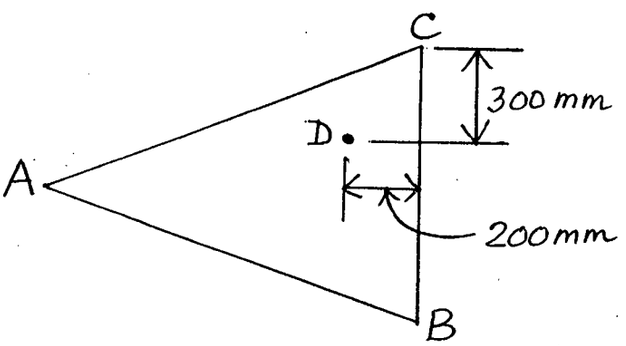

Fig. 3

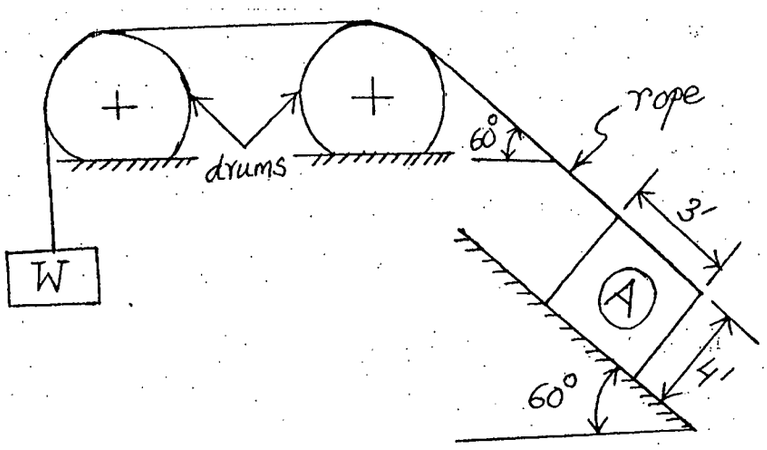

Fig. 4

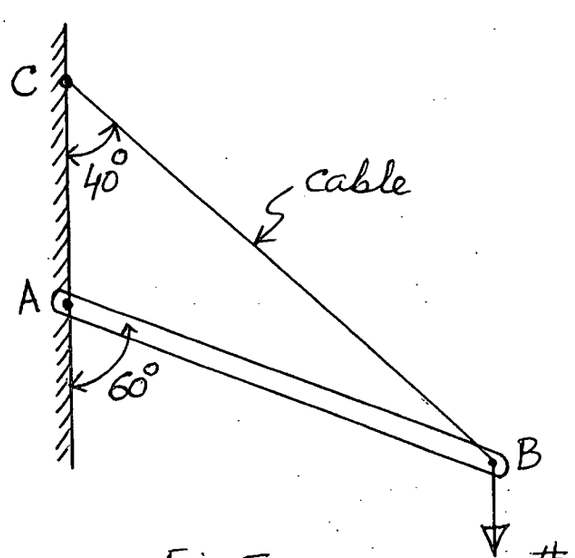

Fig. 5

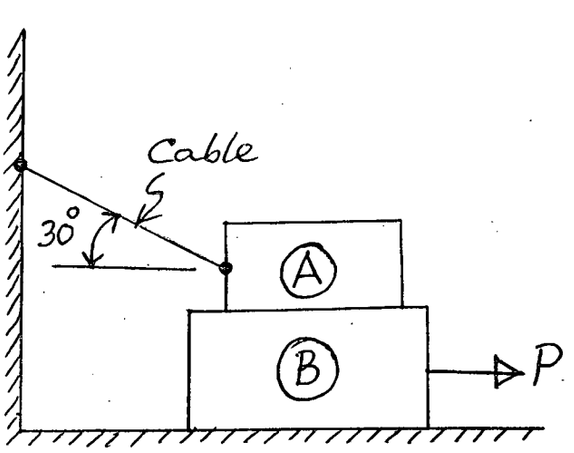

Fig. 6

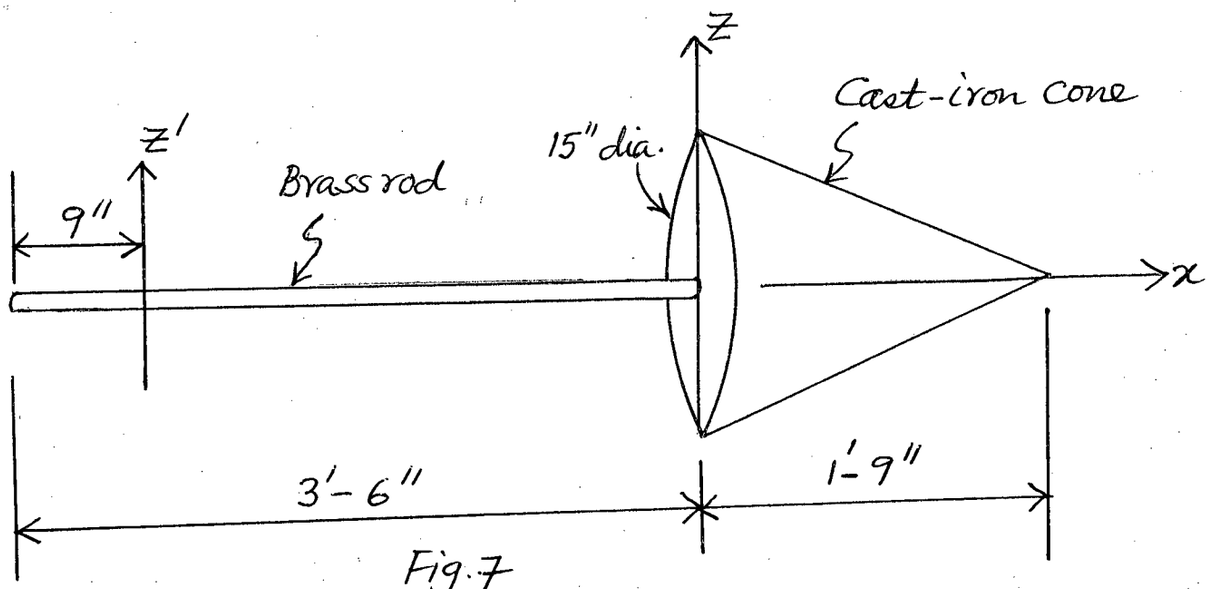

Fig.7

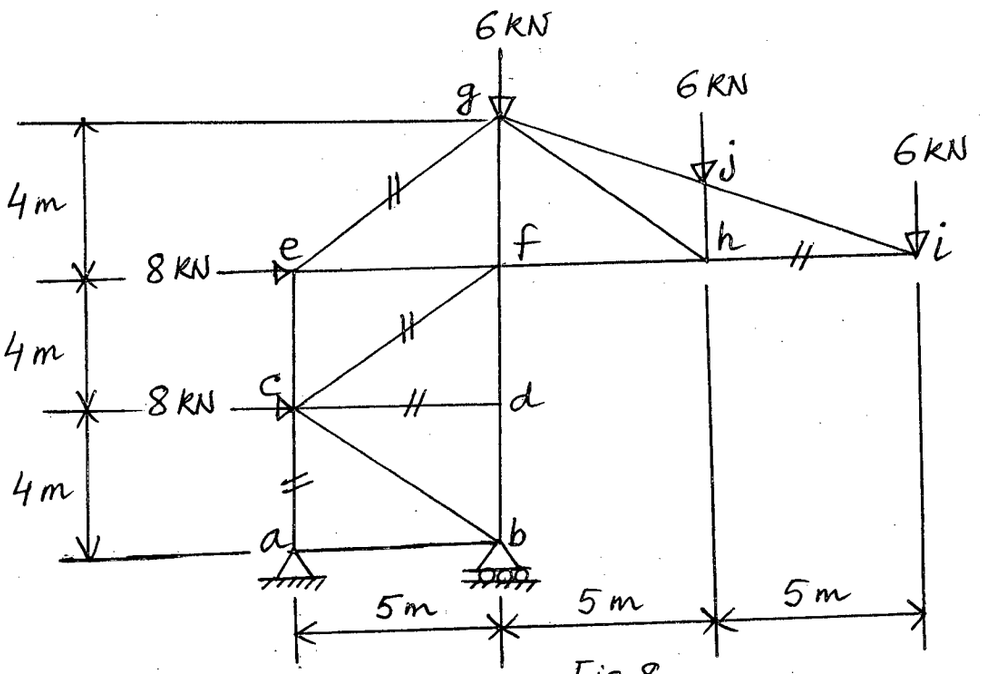

Fig.8

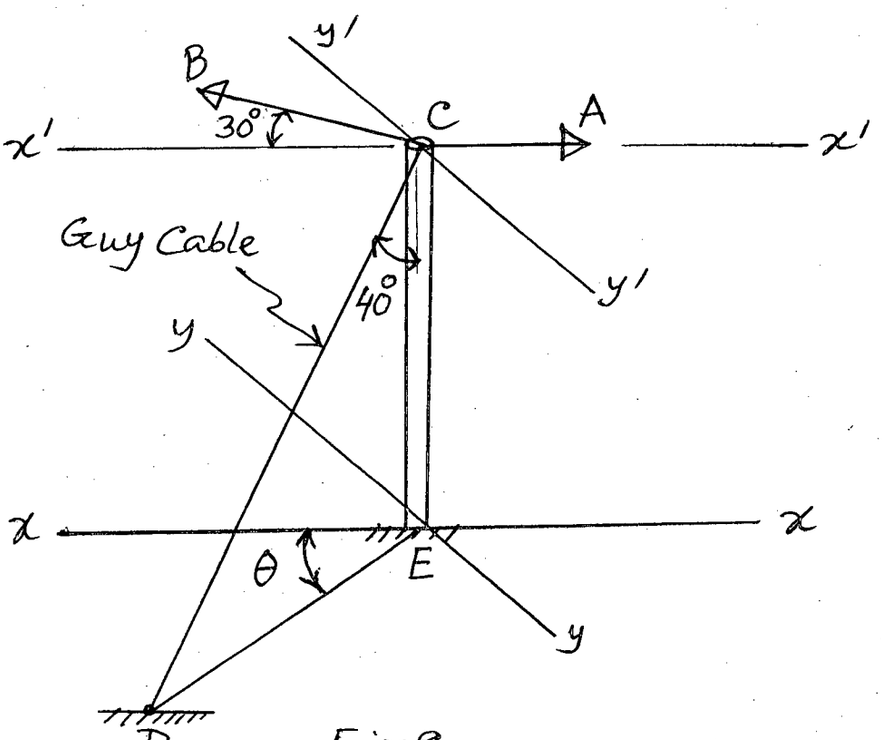

Fig.9

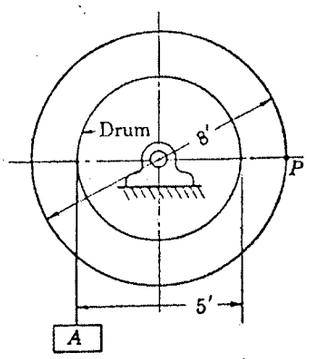

Fig.10

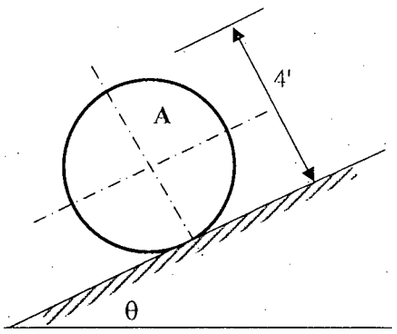

Fig.11

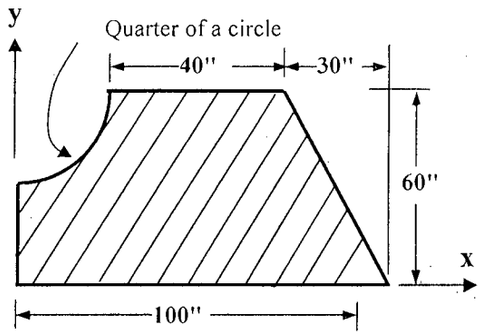

Fig.12

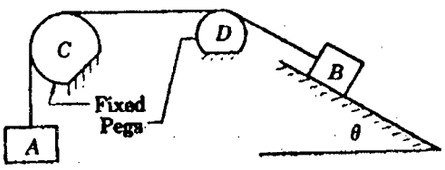

Fig.13

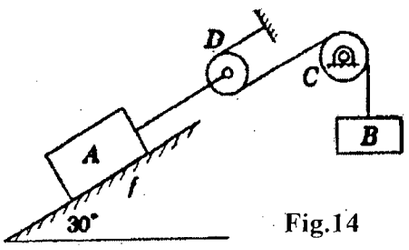

Fig.14

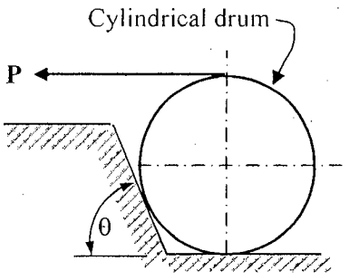

Fig.15

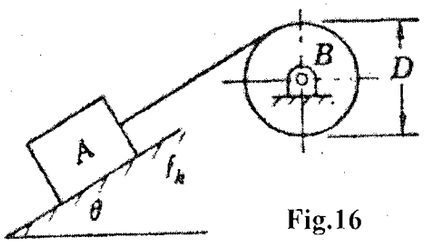

Fig.16

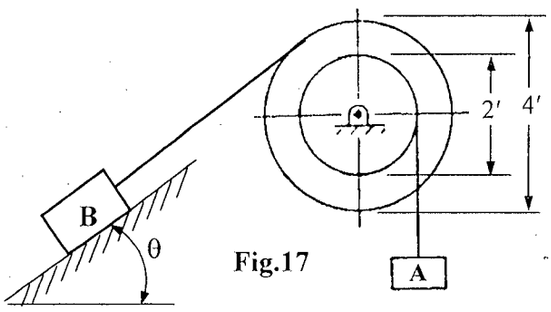

Fig.17

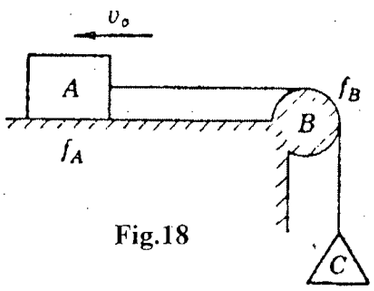

Fig.18

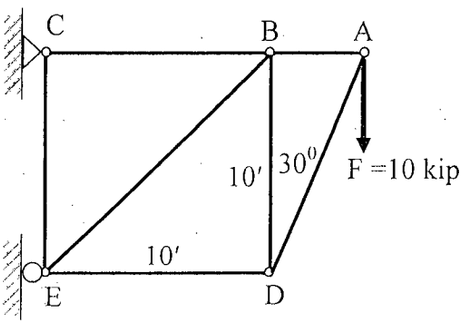

Fig.19

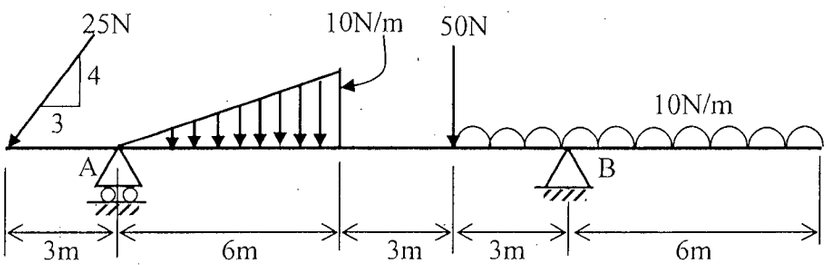

Fig.20

L-1/T-1/CE **Date : 30/07/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2015-2016

Sub : **PHY 101** (Physical Optics, Waves and Oscillation, Heat and Thermodynamics)

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) What is Fresnel's biprism? Explain the formation of coherent sources by Fresnel's biprism. **(7)**

   (b) (i) Using an optical method how can you determine thickness of a piece of transparent cello tape? **(10)**

   (ii) Explain how interference fringes are formed by a Thin wedge-shaped film when examined by normally reflected light and hence find the expression of fringe width. **(12)**

   (c) The distances between slit and biprism and between biprism and eyepiece are 45 cm each. The obtuse angle of biprism is 178° and its refractive index is 1.5. If the fringe width is 15.6×10^{-3} cm, find the wavelength of light used. **(6)**

2. (a) Explain clearly the difference between diffraction and interference of light. **(6)**

   (b) Derive an expression for the intensity distribution due to Fraunhofer diffraction at double-slit and find the condition of missing order when slit separation is twice as that of slit width. **(22)**

   (c) To obtain a double-slit Fraunhofer diffraction pattern, the screen is placed 1.6 m away form the slits. The slit widths are 0.2 mm eah and they are 0.4 mm apart. Calculate the wavelength of light if the fringe width is 2.5×10^{-3} m and also deduce the missing orders. **(7)**

3. (a) What do you mean by plane of polarization of polarized light, optic axis of a crystal and double refraction? **(9)**

   (b) Discuss the theory of production of linearly, circularly and elliptically polarized lights. **(20)**

   (c) The polarizing angle of a piece of glass for green light is 60°. Calculate the angle of minimum deviation for same light passing through a glass-prism of same glass having prism-angle 60°. **(6)**

4. (a) Deduce an expression for Maxwell's law of distribution of velocities of a gas containing N molecules. **(20)**

   (b) Evaluate the average energy of a molecule by using the Maxwell's law of distribution of velocities of a gas molecule. **(15)**

Contd P/2

PHY 101

SECTION – B

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

5. (a) State and prove Carnot's theorem. **(15)**

   (b) State the law of equipartition of energy and establish a relationship between the ratio of two specific heats and the degrees of freedom. **(10)**

   (c) An engine whose temperature of the source is 400K takes 200 calories of heat at this temperature and rejects 100 calories of heat in the sink of temperature 300K. Calculate the efficiency of the engine. **(10)**

6. (a) Describe the construction and the working principle of a Platinum resistance thermometer. **(15)**

   (b) Deduce the Maxwell's thermodynamics relation by using the thermodynamic function. **(20)**

7. (a) Define forced Oscillation. **(5)**

   (b) Establish the differential equation of forced Oscillation. Solve this equation and hence discuss about the resonance. **(20)**

   (c) A massless spring suspended from a rigid support carries a mass of 500 gm at its lower end and the system oscillates with a frequency of 5 Hz. If the amplitude is reduced to half its undamped value in 20s, calculate the force constant of the spring and the relaxation time of the system. **(10)**

8. (a) Define particle velocity and wave velocity. Establish the relation between the particle velocity and wave velocity. **(10)**

   (b) Deduce an expression for the energy density of a plane progressive wave in a medium. **(15)**

   (c) A plane progressive wave train of frequency 400 Hz has a phase velocity of 480 m/s. (i) How far apart are two points 30° out of phase? (ii) What is the phase difference between two displacements at a given point at time 10^{-3}s apart? **(10)**

L-1/T-1/CE **Date : 03/08/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2015-2016

Sub : **HUM 355** (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) How did inventions change the way cotton and its products were manufactured? Which were the most important inventions during industrial revolution? **(13 ⅓)**

   (b) In particular, what combination of advantages allowed Britain to experience industrialization first? **(10)**

2. (a) Analyze Weber's Ideal Type' of Bureaucracy with examples from your society. **(13 ⅓)**

   (b) Catalogue the reasons of poverty in our society. Prepare some suggestions to policy makers with a view to overcoming the poverty situation. **(10)**

3. (a) Is pollution always caused by humans? Correlate your ideas with arguments. **(13 ⅓)**

   (b) Demonstrate Harris and Ullman's 'Multiple Nuclei Model' for layout of a city. **(10)**

4. Write short notes on any THREE of the followings: **(23 ⅓)**

   (a) Malthusian theory of population. (b) Population pyramid
   (c) Neonatal Mortality (d) Soil Pollution.

SECTION – B

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

5. (a) Define culture. Explain why values and norms are considered important elements of culture. **(10)**

   (b) What is dominant ideology? How dominant ideology influence the popular culture of a world. **(13 ⅓)**

6. (a) What do you understand by family? Discuss different types of family practices all over the society? **(10)**

   (b) Illustrate the primary functions of family identified by W.F. Ogburn. **(13 ⅓)**

7. (a) What is social mobility? Explain horizontal mobility and vertical mobility highlighting open vs. closed stratification systems. **(10)**

   (b) Discuss different system of social stratification in the context of Bangladesh. **(13 ⅓)**

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

   (a) Sociological imagination. (b) Sociology and other social sciences.
   (c) Functionalist theoretical perspective. (d) Cultural lag.

L-1/T-1/CE **Date : 03/08/2016**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-1/T-1 B. Sc. Engineering Examinations 2015-2016

Sub : **HUM 375** (Government)

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) Make a comparative analysis between parliamentary and presidential forms of government. **(11 1/3)**

   (b) What is local government? Discuss the functions of local government in a state. **(12)**

2. (a) What is 'Good Governance'? Explain the prerequisites of good governance. **(11 1/3)**

   (b) Define rights. Describe the 'rights' of a citizen in a democratic state. **(12)**

3. (a) Review the functions of executive and judiciary in a state. **(11 1/3)**

   (b) What are the features of bureaucracy? Briefly discuss the functions of bureaucracy. **(12)**

4 Write short notes on any three (03) of the following: **(23 1/3)**

   (a) Dictatorship (b) Nationalism (c) Sovereignty (d) Constitution

SECTION – B

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

5. (a) Do you think the disintegration was the main reason behind the emergence of Bangladesh? Give reasons in favour of your answer. **(12)**

   (b) Discuss the six-point movement and its impact on the struggle for independence. **(11 1/3)**

6. (a) Define constitution. Discuss the basic principles of Bangladesh constitution of 1972 and the changes in the constitution after the 5^{th} amendment. **(11 1/3)**

   (b) Define foreign policy. Discuss the determinants and main principles of Bangladesh foreign policy. **(12)**

7. (a) How is welfare state different from a socialist country? **(11 1/3)**

   (b) What do you know about United Nations Organization? Discuss the successes and failures of United Nations Organization. **(12)**

8. (a) Define public policy. Describe the policy making process in Bangladesh. **(11 1/3)**

   (b) What is meant by E-government? Discuss the advantages and disadvantages of E-government. **(12)**