

**KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY**

**Department of Energy Science and Engineering**

B. Sc. Engineering 2<sup>nd</sup> Year 2<sup>nd</sup> Term Examination, 2018

Math 2213

(Complex Variable and Fourier Analysis)

Time: 3 Hours.

Full Marks: 210

N.B. i) Answer any THREE questions from each section in separate scripts.

ii) Figures in the right margin indicate full marks.

iii) Assume reasonable data if any missing.

**SECTION - A**

- 1(a). Define periodic function and its period with an example. 05
- 1(b). Find a series of sines and cosines of multiples of  $x$  which will represent  $x + x^2$  in the interval  $-\pi < x < \pi$ . Hence, deduce that, 17

$$\sum_{n=1}^{\infty} \frac{1}{n^2} = \frac{\pi^2}{6}$$

- 1(c). Define odd and even function. If  $f(t) = t^2, 0 \leq t \leq 1$  find its half range sine series. 13

- 2(a). Find the Fourier series of the function, 17

$$f(x) = \begin{cases} -\cos x, & -\pi < x < 0 \\ \cos x, & 0 \leq x < \pi \end{cases}$$

- 2(b). Use parsevals identity to the function  $f(x) = \sin x, 0 < x < \pi$  and show that, 18

$$\frac{1}{1^2 \cdot 3^2} + \frac{1}{3^2 \cdot 5^2} + \frac{1}{5^2 \cdot 7^2} + \dots = \frac{\pi^2 - 8}{16}$$

- 3(a). Find a partial differential equation by eliminating  $a, b, c$  from 07

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$$

- 3(b). Form a partial differential equation by eliminating the arbitrary function  $\phi$  from 10

$$\phi(x + y + z, x^2 + y^2 - z^2) = 0$$

- 3(c). If both the ends of a bar of length  $l$  are at temperature zero and the initial temperature is to be prescribed function  $F(x)$  in the bar, then find the temperature at a subsequent time  $t$ . 18

- 4(a). A long rectangular plate of width  $a$  cm with insulated surface has its temperature  $u$  equal to zero on the both long sides and one of the short sides so that, 18

$$u(0, y) = 0, u(a, y) = 0, u(x, \infty) = 0, u(x, 0) = kx.$$

Show that the steady state temperature with in the plate is,

$$u(x, y) = \frac{2ak}{\pi} \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n} e^{-n\pi y/a} \sin \frac{n\pi x}{a}$$

- 4(b). The diameter of a semicircular plate of radius  $a$  is kept at  $0^\circ\text{C}$  and the temperature at the semicircular boundary is  $T^\circ\text{C}$ . Determine the steady state temperature in the plate. 17

**SECTION - B**

- 5(a). Define limit of a complex function with an example. 05
- 5(b). Examine the continuity and differentiability of  $f(z) = |z|^2$  at origin. 12
- 5(c). Determine whether the function  $u(x, y) = 3x^2y + 2x^2 - y^3 - 2y^2$  is harmonic or not. If the function is harmonic, find the conjugate harmonic function of  $v(x, y)$  and express  $u + iv$  as an analytic function of  $z$ . 18
- 6(a). Define with example (i) singular point, (ii) poles, (iii) Branch points, (iv) Removable singularity and (v) essential singularity. 15
- 6(b). Find the singular points of the following functions and determine their nature: 10
- (i)  $f(z) = \frac{1}{z(e^z-1)}$       (ii)  $f(z) = \frac{z^2}{(z+1)^2} \sin\left(\frac{1}{z-1}\right)$
- 6(c). Evaluate,  $\oint_c \frac{e^{3z}}{z-\pi i} dz$ , where  $c$  is the curve  $|z-2| + |z+2| = 6$ . 10
- 7(a). Evaluate,  $\oint_c \frac{\sin \pi z^2 + \cos \pi z^2}{(z-1)(z-2)} dz$  13
- 7(b). Write Bessel's differential equation and first kind of Bessel's function. 07
- 7(c). Prove the following recurrence relation, 10
- $$\frac{d}{dx} [x^n J_n(x)] = x^n J_{n-1}(x)$$
- 7(d). Prove that, 05
- $$\cos(x \sin \theta) = J_0(x) + \sum_{n=1}^{\infty} 2 J_{2n}(x) \cos 2n\theta.$$
- 8(a). Evaluate the integral,  $\oint_C \frac{1}{z^2+9} dz$ ,  $C$  is the square bounded by  $x = \pm 2$  and  $y = \pm 2$  08
- 8(b). Prove that, 12
- $$J_{3/2}(x) = \sqrt{\frac{2}{\pi x}} \left( \frac{\sin x}{x} - \cos x \right)$$
- 8(c). Prove that, 15
- $$\exp\left\{\frac{1}{2}x\left(z - \frac{1}{z}\right)\right\} = \sum_{n=-\infty}^{\infty} z^n J_n(x)$$

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**Department of Energy Science and Engineering**

B. Sc. Engineering 2<sup>nd</sup> year 2<sup>nd</sup> Term Examination, 2018

EE 2213

(Power Electronics)

Time: 3 Hours.

Full Marks: 210

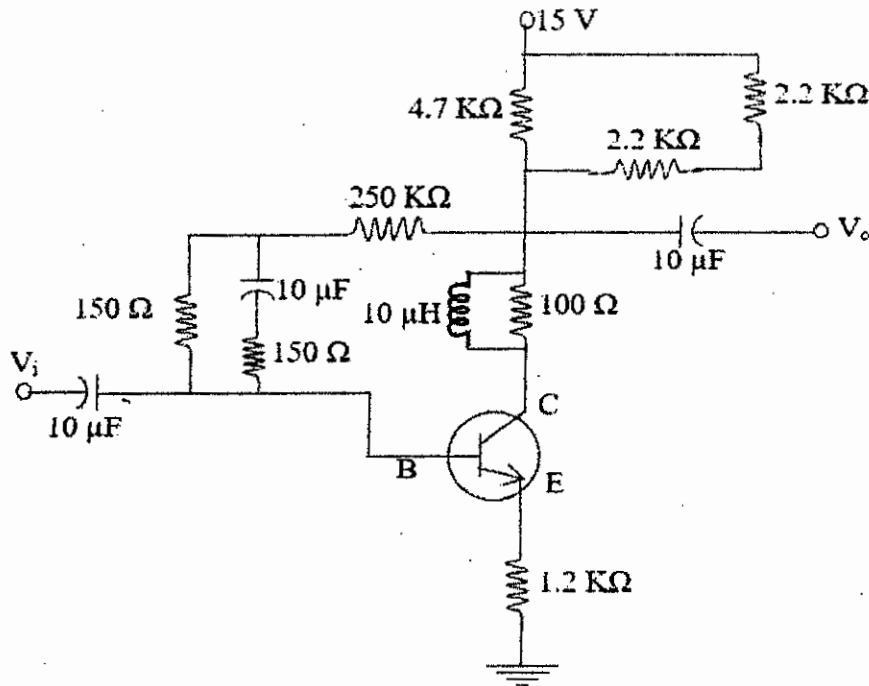
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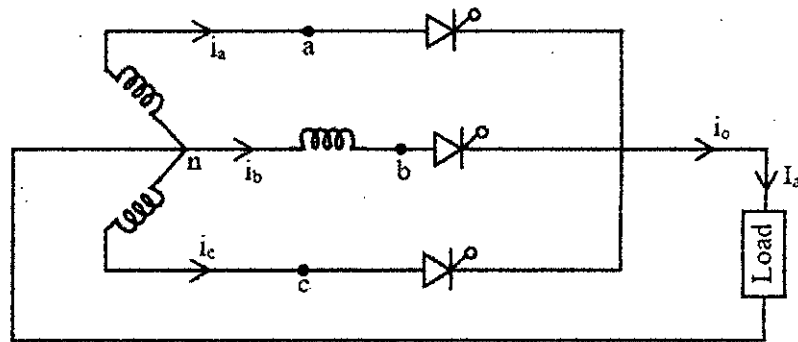
**SECTION - A**

- 1(a). "Transistor acts as both switch and amplifier"-Justify the statement. 12
- 1(b). What is biasing for a BJT transistor? For emitter stabilized bias circuit prove that, 10
- $$I_B = \frac{V_{CC} - V_{BE}}{R_B + (\beta + 1)R_E}$$
- 1(c). Draw the input and output characteristics graph of common emitter configuration and find out the reason of gradual shift of input graph with the increase of collector-emitter voltage. 13
- 2(a). Calculate  $I_C$  and  $I_E$  for a transistor that has  $\alpha_{dc} = 0.97$ ,  $I_B = 120 \mu A$ . Also determine the value of  $\beta_{dc}$  for transistor. 08
- 2(b). Determine  $I_B$ ,  $I_C$ ,  $V_{CE}$ ,  $V_C$ ,  $V_E$ ,  $V_B$ , and  $V_{BC}$  for the below circuit in figure. Here  $\beta = 90$ . 20

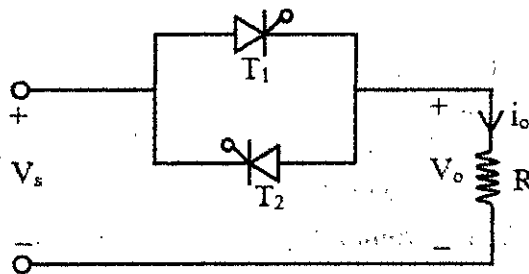


- 2(c). Define transistor saturation. Summarize the effect of temperature on bias stabilization in brief. 07
- 3(a). Define transformer utilization factor. Draw and explain block diagram of power electronics in short. 06
- 3(b). Write the basic operation of single phase full wave converter with block diagram and waveform. Also compare various mode of operation. 14

- 3(c). A three-phase half wave converter shown in figure is operated from a three-phase Y-connected 208 V, 60 Hz supply and the load resistance is  $R = 100 \Omega$ . If it is required to obtain an average output voltage of 88% of the maximum possible output voltage, calculate (i) the delay angle  $\alpha$ , (ii) the rms and average output currents, (iii) the average and rms thyristor currents (iv) the rectification efficiency.



- 4(a). Define power factor. Describe the basic principle of phase control with appropriate circuit and waveform. 08
- 4(b). How the transistor is turned on? Write about the method. 07
- 4(c). A single phase full-wave ac voltage controller in figure has a resistive load of  $R = 10 \Omega$  and input voltage is  $V_s = 120 \text{ V (rms)}$ , 60 Hz. The delay angles of thyristor  $T_1$  and  $T_2$  are  $\alpha_1 = \alpha_2 = \alpha = \pi/2$ . Determine (i) rms output voltage,  $V_o$ , (ii) input power factor, (iii) average current of thyristor  $I_A$ , (iv) rms current of thyristor,  $I_R$ . 15

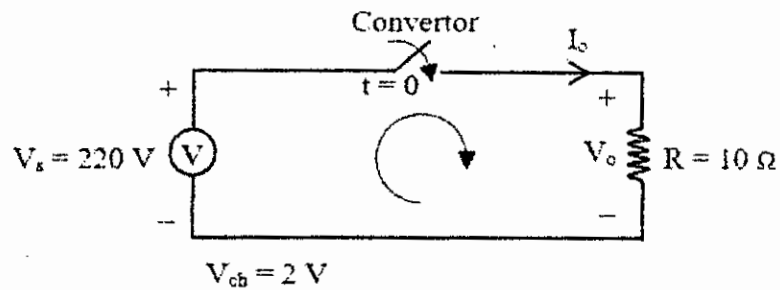


- 4(d). Draw the waveform for resistive load of single phase cycloconverter. 05

### SECTION - B

- 5(a). Distinguish between field effect transistor and bipolar junction transistor. 06
- 5(b). Write down the basic operation and characteristics of n-channel depletion-type MOSFET with appropriate diagram. 13
- 5(c). Write about advantage and application of VMOS. 06
- 5(d). Sketch the transfer and drain characteristics of an n-channel depletion type MOSFET with  $I_{DSS} = 12 \text{ mA}$ ,  $V_p = -6 \text{ V}$  for a range of  $V_{GS} = -V_p$  and  $V_{GS} = IV$ . 10
- 6(a). Depending on the directions of current and voltage flows, write down the classification of dc converters and briefly discuss about four-quadrant converter. 10
- 6(b). What is step up converter? For a boost regulator, prove that  $\Delta V_c = \frac{I_a(V_a - V_s)}{V_a f_c}$  and draw the circuit diagram with wave forms. 15

- 6(c). The dc converter in figure has resistive load of  $R = 10 \Omega$  and the input voltage is  $V_s = 220$  V. When the converter switch remains on, its voltage drop is  $V_{ch} = 2$  V and the chopping frequency is  $f = 1$  kHz. If the duty cycle is 50%, determine (i) the average output voltage  $V_o$ , (ii) the rms output voltage  $V_o$ , (iii) the converter efficiency, (iv) the effective input resistance  $R_i$  of the converter. 10



- 7(a). What is pulse width modulation (PWM)? Draw the wave forms and discuss about sinusoidal pulse width modulation. 12
- 7(b). For a three phase inverter discuss and draw the circuit diagram with wave form for 180 degree conduction. 15
- 7(c). Define 08
- Harmonic factor of n-th harmonic (HF<sub>n</sub>)
  - Total harmonic distortion (THD)
  - Lowest order harmonic (LOH)
- 8(a). Write short note about 15
- Line commutated thyristor circuit.
  - Forced commutated thyristor circuit
  - Uninterruptible power supply (UPS).
- 8(b). Define reverse recovery time. The reverse recovery time of a diode is  $t_r = 5 \mu s$  and the rate of fall of the diode current is  $di/dt = 80$  A/ $\mu s$ . If the Softness factor is  $SF = 0.5$ , determine (i) the storage Charge  $Q_{RR}$  (ii) the peak reverse current  $I_{RR}$ . 12
- 8(c). Describe the basic operation, symbol and characteristics of DIAC. 08

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**KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY**

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B. Sc. Engineering 2<sup>nd</sup> Year 2<sup>nd</sup> Term Examination, 2018

Hum 2213

(Economics and Accounting)

Time: 3 Hours.

Full Marks: 210

N.B. i) Answer any THREE questions from each section in separate scripts.

ii) Figures in the right margin indicate full marks.

iii) Assume reasonable data if any missing.

**SECTION – A**

- 1(a). How Economics is like a “Science”? Explain the idea of Economics, Microeconomics, and Macroeconomics. 15
- 1(b). Draw a production possibilities frontier for a society that produces food and clothing. Show an efficient point, an inefficient point, and an infeasible point. Show the effects of a drought. 15
- 1(c). Use a production possibilities frontier to describe the idea of “efficiency.” 05
- 2(a). What is demand? On a supply and demand diagram, show equilibrium price, quantity and total revenue received by producer. Explain. 20
- 2(b). How price elasticity of demand change total revenue? Explain with necessary diagram. 15
- 3(a). Draw and explain the marginal cost and average total cost curves for a typical firm. Explain why the curves have the shapes that they do and why cross where they do. 15
- 3(b). What is meant by a competitive firm? Under what conditions will a firm shut down temporarily and exit a market? Explain. 20
- 4(a). What is Gross Domestic Product (GDP), Real GDP, and GDP growth? 15
- 4(b). What is National savings, private savings and public savings? Describe a tax-code that might increase savings and investment. If this policy was implemented, how would it affect the market for loanable funds? Explain. 20

**SECTION – B**

- 5(a). Define accounting. State the importance of accounting. 10
- 5(b). What is conceptual framework of accounting? Discuss the principles of accounting. 20
- 5(c). Specify the steps of accounting cycle. 05
- 6(a). Tony opened Top Clean Laundromat on September 1, 2017. During the first month of operation, following transactions occurred: 25
- September 1: Invested tk. 20,000 cash in the business.
- September 2: Paid tk. 1,000 cash for store rent for the month of September.
- September 3: Purchased washer and dryers for tk. 25,000 paying tk. 10,000 in cash and signing a tk. 15,000, 6-month, 12% note payable.
- September 4: Paid tk. 1,200 for one year accident insurance policy.
- September 10: Received bill from the Daily News for advertising the Laundromat tk. 200.
- September 30: Determined that cash receipts for laundry services for the month were tk. 6,200.
- Requirement: (i) Journalize the transactions  
(ii) Post the transactions to ledger accounts.

- 6(b). What are the errors not disclosed by a trail balance? 10
- 7(a). Define cost. Classify cost in relation to an accounting period. 10
- 7(b). What are the factors that should be considered while calculating depreciation? 10
- 7(c). Discuss the methods of computing depreciation of a plant asset. 15
- 8(a). Distinguish between trial balance and balance sheet. 07
- 8(b). Following balances are extracted from the ledger of Nupur Company as on 30th June, 2002: 28

Title of accounts	tk.
Capital	2,80,000
Sales	3,70,000
Purchase returns	5,000
Accounts Payable	36,000
Notes Payable (Due on 30.12.2002)	6,000
Purchases	3,20,000
Sales return	1,200
Accounts Receivable	1,00,000
Furniture	1,20,000
Office equipment	82,000
Cash	30,000
Inventory (Opening)	14,000
Insurance	3,600
Office supplies	2,800
Rent	1,200
Salaries	6,400
Drawings	1,800
Advertisement	3,000
Delivery expenses	7,000
Freight-in	4,000

The following adjustments are to be made on 30th June, 2002 : (a) Inventory at closing tk. 61,000, (b) Unexpired Insurance tk. 400, (c) Accrued salaries tk. 1,600, (d) Accrued rent tk. 1,600, (e) Depreciation is to be provided on office equipment @ 10% and on furniture @ 5%, (f) Office supplies in hand tk. 800, (g) The inventory at the end includes goods worth tk. 1,500 for which bills has neither been received nor accounted for, (h) Nupur took goods costing tk. 250 for personal use and no record of it was maintained in the books of accounts.

Required: (i) Prepare a statement of comprehensive income  
(ii) Prepare a statement of financial position.

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B. Sc. Engineering 2<sup>nd</sup> Year 2<sup>nd</sup> Term Examination, 2018

ESE 2209

(Bio and Wind Energy Engineering)

Time: 3 Hours.

Full Marks: 210

N.B. i) Answer any THREE questions from each section in separate scripts.

ii) Figures in the right margin indicate full marks.

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**SECTION – A**

- 1(a). Define biomass and bioenergy. How biomass energy is formed? Write down advantages and disadvantages of biomass and bioenergy. 08
- 1(b). Explain the formation of biomass energy through photosynthesis process with neat sketches. 12
- 1(c). Describe the working principle of biomass briquetting as well as flow diagram of briquette production. 08
- 1(d). What are the environment and social benefits by using biomass briquetting? 07
- 2(a). What is biogas? State the composition of biogas. Write down the name of necessary conditions for anaerobic digestion of organic wastes. 06
- 2(b). Discuss in details the anaerobic digestion process. Explain the parameter to be controlled to achieve the biogas production efficiently. 12
- 2(c). Suppose a farmer has: 4 cows each producing about 8 kg/day of dung and 2 buffaloes each producing 13 kg/day of dung. Can he meet the energy demand to cook for a family of 8 person and one lamp for 3 hours per day?  
Given, Gas production per kg of cow dung =  $0.03 \text{ m}^3$ , Gas requirements for cooking =  $0.3 \text{ m}^3/\text{person}$ , Gas requirement for lighting one lamp =  $0.15 \text{ m}^3/\text{hr}$ . 07
- 2(d). Describe the working principle of floating-down type biogas plant with schematic diagram. 10
- 3(a). What is pyrolysis of biomass? What are the main differences between fast pyrolysis and slow pyrolysis? 08
- 3(b). Explain the working principle of fixed bed pyrolysis reactor process with neat sketches. 12
- 3(c). Why Life Cycle Assessment (LCA) is so important for production of alternative fuels through pyrolysis process? 05
- 3(d). What is bioethanol? Describe the principle of bioethanol production through continuous fermentation processes. 10
- 4(a). Distinguish between BOD and COD. 07
- 4(b). 5 ml of wastewater is diluted to 250 ml distilled water in standard BOD bottle. Initial DO in the bottle is determined to be 8.5 mg/l. DO after 5 days at 20 °C is found to be 5 mg/l. Determine BOD<sub>5</sub> of wastewater and compute the ultimate BOD. 10
- 4(c). What is biodiesel? Explain in details the steps involved in the production of biodiesel from vegetable oil. 08
- 4(d). Why we need biomass conversion? Explain the production process of getting syngas from biomass. 10

## SECTION – B

- 5(a). Define: (i) Instantaneous wind speed; (ii) Average wind speed; (iii) Starting threshold speed; and (iv) Hybrid power system. 10
- 5(b). Classify and explain the wind turbine generators with schematic diagram. 15
- 5(c). Discuss about operating regions of the wind turbine. 10
- 
- 6(a). What are the environmental benefits and problems of wind energy? Discuss. 12
- 6(b). Write short notes on: (i) Factors influencing the wind energy economics, (ii) Energy Payback Ratio (EPR) and Energy Payback Period (EPP), (iii) Cost of wind energy system. 12
- 6(c). A wind turbine generates 1576800 KWh in a year. The generated electricity is sold to the utility at a rate of 5 cents/KWh. The discount rate is 5 percent. Calculate the present worth of electricity generated by the turbine throughout its life period of 20 years. 11
- 
- 7(a). Which input parameters are to be identified for rotor design of a wind turbine? Discuss. 10
- 7(b). Using the Axial momentum theory, prove that the velocity of the wind stream at the rotor section of wind turbine is the average of the velocities at its up-stream and down-stream sides. 15
- 7(c). What is the impact of tower height of a wind turbine on power system? Discuss. 10
- 
- 8(a). What is the general setup needed for wind turbine measurements? 10
- 8(b). Define air density and humidity. Classify wind turbines based on the axis of rotation. Discuss its various components with schematic diagram. 15
- 8(c). Consider a wind turbine with 5 m diameter rotor. Speed of the rotor at 10 m/s wind velocity is 130 r/min, and its power coefficient at this point is 0.35. Calculate the tip speed ratio and torque coefficient of the turbine. What will be the torque available at the rotor shaft? Assume the density of air to be  $1.24 \text{ kg/m}^3$ . 10

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**KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY**

**Department of Energy Science and Engineering**

B. Sc. Engineering 2<sup>nd</sup> Year 2<sup>nd</sup> Term Examination, 2018

ME 2213

(Dynamics and Kinematics of Machineries)

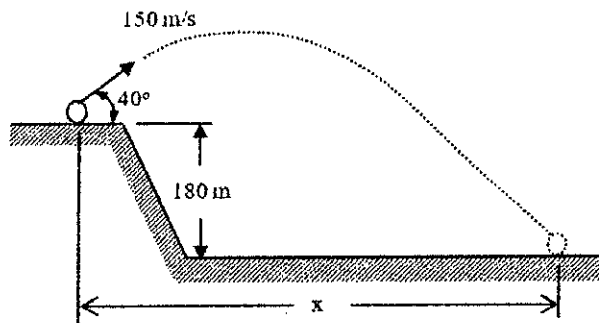
Time: 3 Hours.

Full Marks: 210

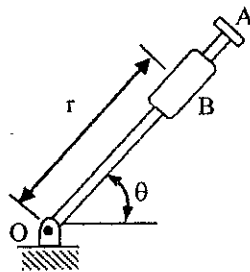
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**SECTION – A**

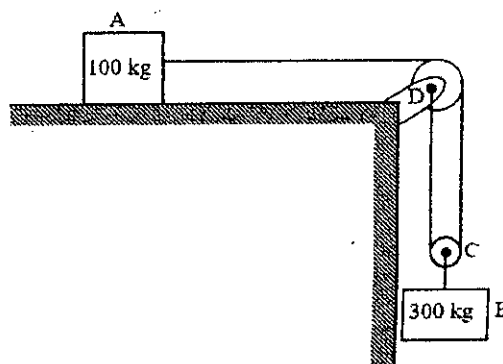
- 1(a). Two automobiles A and B are traveling in the same direction in adjacent highway lanes. Automobile B is stopped when it is passed by A, which travels at a constant speed of 15 mi/h. Two seconds later, automobile B starts and accelerates at a constant rate of  $0.90 \text{ m/s}^2$ . Determine – (i) when and where B will overtake A; (ii) the speed of B at that time. 18
- 1(b). A projectile is fired from the edge of a 180 m cliff with an initial velocity of 150 m/s, at an angle of  $40^\circ$  with the horizontal. Neglecting the air resistance, find – (i) the horizontal distance from the gun to the point where the projectile strikes the ground; (ii) the greatest elevation above the ground reached by the projectile. 17



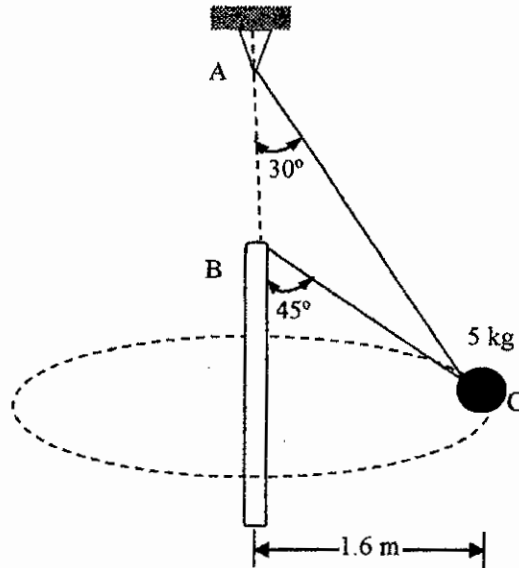
- 2(a). The rotation of rod OA about O is defined by the relation  $\theta = 2t^2$ , where  $\theta$  is expressed in radians and  $t$  in seconds. Collar B slides along the rod in such a way that its distance from O is  $r = 60t^2 - 20t^3$ , where  $r$  is expressed in meters and  $t$  in seconds. When  $t = 1 \text{ s}$ , determine – (i) the total velocity of the collar; (ii) the total acceleration of the collar; (iii) the acceleration of the collar relative to the rod. 18



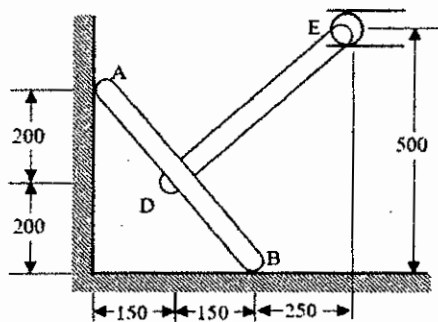
- 2(b). The two blocks shown start from rest. The horizontal plane and the pulley are frictionless and the pulley is assumed to be of negligible mass. Determine the acceleration of each block and the tension in each chord. 17



- 3(a). What is impact? Define direct impact and oblique impact. 17
- 3(b). Prove that “the kinetic energy of particle at position 2 may be obtained by adding its kinetic energy at position 1 with the work done during the displacement from position 1 to position 2 by the force exerted on the particle.”
- 3(c). A single wire ACB passes through a ring at C attached to a sphere which revolves at a constant speed  $v$  in the horizontal circle shown. Knowing that the tension is the same in both portions of the wire, determine the speed  $v$ .



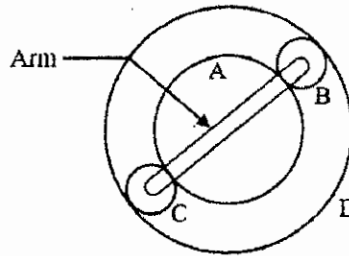
- 4(a). Apply the principle of work and energy for solving the problem stated as- 10  
Two blocks are joined by an inextensible cable as shown. If the system is released from rest, determine the velocity of block A after it has moved 2 m. Assume that the coefficient of kinetic friction between block A and the plane is  $\mu_k = 0.25$  and that the pulley is weightless and frictionless.
- 4(b). Show that, general plane motion is sum of a translation and rotation. 07
- 4(c). Two 500 mm rods are pin connected at D as shown. Knowing that B moves to the left with a constant velocity of 360 mm/s, determine at the instant shown – (i) angular velocity of each rod; (ii) velocity of E. 18



### SECTION – B

- 5(a). Draw and explain the turning moment diagram of four stroke IC engine. 10
- 5(b). How does governor and flywheel differ? 08
- 5(c). The turning moment diagram for a multi-cylinder engine has been drawn to a scale 1 mm = 600 N-m vertically and 1 mm =  $3^\circ$  horizontally. The intercepted areas between the output torque curve and the mean resistance line, taken in order from one end, are as follows: +52, -124, +92, -140, +85, -72 and +107 mm<sup>2</sup>, when the engine is running at a speed of 600 rpm. If the total fluctuation of speed is not to exceed  $\pm 1.5\%$  of the mean, find the necessary mass of the flywheel of radius 0.5 m. 17

- 6(a). Why Idle gears are used? 05
- 6(b). Evaluate that "The common normal to the point of contact between a pair of teeth must always pass through the pitch point". 13
- 6(c). An epicyclic train of gears is arranged as shown in figure. How many revolutions does the arm to which pinions B and C are attached make? 17
- (i) when A makes one revolution clockwise and D makes half a revolution anticlockwise;
- (ii) when A makes two revolution clockwise and D is stationary.
- The number of teeth on the gears A and D is 40 and 90 respectively.



- 7(a). Discuss the effect of partial balancing of reciprocating parts in two cylinder locomotives. 10
- 7(b). Why partial balancing is done for unbalanced primary force in a reciprocating engine? 10
- 7(c). Derive the expression of balancing V engine. 15
- 8(a). How does a governor work? 07
- 8(b). Define controlling force. Explain the controlling force diagram for a hartnell governor. 13
- 8(c). The arms of a porter governor each 30 cm long and are pivoted on the governor axis. Mass of each ball is 2 kg. At the mean speed of 150 rpm, the arm makes  $30^\circ$  with the vertical. Determine the central load and sensitivity of the governor if the sleeve movement is  $\pm 2.5$  cm. 15

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