

Enrollment No. 17UBE063

S₃(UBE03C14)BE

B.Tech 3rd Semester End-Term Examination, 2018

Fluid Mechanics
Paper Code: UBE03C14

Full Marks: 100

Time: 3 hours

Answer any ten questions below:

1. Draw a neat diagram of both the single acting displacement and double acting displacement pump and derive the power equation, slip, theoretical flow rate for both the cases. [10]
 2. A packed bed reactor of a catalytic reformer was filled up with spherical catalyst of diameter 0.5 cm and air at 37°C flows through at a flow rate of 100 kg/h, with 15 bar internal pressure. The molecular weight of air is 60 g/mol and the viscosity of air at specified temperature is 2.5×10^{-5} kg/m s. The internal diameter of reactor is of 5 cm and length of the reactor is of 30 m. The porosity of the spherical particles were found to be 0.40 and assume a mixed flow (both laminar and turbulent) inside the packed bed reactor. Determine the outlet pressure based on Ergun equation. [10]
 3. Answer the following: [10]
 - a. A double acting pump: has a bore of 200 mm with piston rod dia 140 mm. the extend speed of piston is 80 mm/s. If the flow rate of oil during retraction and extension is same, find out the retract speed of the piston in mm/s. [5]
 - b. Find the slip, % of slip, theoretical discharge and Coefficient of discharge, if speed of the pump is 50 rpm with actual discharge of 0.01 m³/s; diameter of the cylinder 200mm; length of the stroke 400 mm. [5]
 4. The power input P to a centrifugal pump is assumed to be a function of the volume flow Q, impeller diameter D, rotational rate Ω , and the density ρ and viscosity μ of the fluid. Rewrite this as a dimensionless relationship taking Ω , ρ and D as repeating variables.
- A two-dimensional incompressible flow field is defined by the velocity components $u = 2V\left(\frac{x}{L} - \frac{y}{L}\right)$ and $v = -2V\frac{y}{L}$ where V and L are constants. If they exist, find the stream function and velocity potential. [5+5=10]
5. Discuss the working principles of (i) Bourdon tube, (ii) Bellow gage and (iii) McLeod gage. [10]
 6. What do you mean by entrance length of a pipe? Describe with schematic diagram.
1.5 inch diameter water pipe is 60 ft long and delivers water at 5 gal/min at 20°C. What fraction of this pipe is taken up by the entrance region? Given, 1 gallon = 0.1336 cubic feet and 1 inch = 1/12 ft.

Find out the volumetric flow rate of water in a circular pipe having a diameter of 5 cm so that the flow regime reaches transition to turbulence. Given, density and coefficient of viscosity of water is 1000 kg/m^3 and 0.001 kg/m.s respectively.

[2+3+3+2=10]

What do you mean by hydraulic diameter?

7. What are turbulent stresses? Depict how the turbulent stresses affect the shear stress and velocity distribution near a wall.

Describe how the flow gets separated from the diffuser wall to result in a stalled flow.

If the area ratio of a diffuser is 5:1, calculate its frictionless pressure recovery coefficient.

If oil having kinematic viscosity of $0.0002 \text{ m}^2/\text{s}$ is undergoing laminar flow with an average velocity of 3 m/s in a pipe of circular cross-section having diameter of 6 cm, calculate the friction factor in the flow.

[2+4+2+2=10]

8. What do you mean by Reynolds decomposition in connection to turbulent flow? Why is it required?

Deduce time-averaged continuity and momentum equation for turbulent fluid flow. [2+8=10]

9. Describe principle operation along with schematic diagram for (a) Pitot static tube, (b) laser Doppler anemometer, (c) particle image velocimetry. [10]

10. Describe choking in a compressible flow.

Air flows adiabatically through a duct. At point 1, the flow velocity is 200 m/s, temperature is 350 K and pressure is 180 kPa. Compute (a) T_0 , (b) p_0 , (c) ρ_0 , (d) Ma , (e) V_{\max} , and (f) V^* . At point 2 further downstream, is the velocity is 300 m/s and pressure is 130 kPa. (g) What is the stagnation pressure at point 2? Given, for air $R = 287 \text{ m}^2/\text{s}^2.\text{K}$, $k=1.4$ and $c_p=1005 \text{ m}^2/\text{s}^2.\text{K}$. [3+7=10]

11. Explain why a converging-diverging nozzle can generate supersonic flow, while a diverging-converging nozzle cannot.

Derive Rankine-Hugoniot relation in normal shock waves in a compressible flow. [3+7=10]

12. What do you mean by open-channel flow? What are the dominant forces in open-channel flow?

What do you mean by hydraulic jump? Classify hydraulic jump on the basis of Froude number.

Derive Chezy's formula for uniform open-channel flow.

[1+1+4+2 =10]

Enrolment No. []

S.(UBE03B03)BE

B.Tech 3rd Semester End-Term Examination, 2018
Human Physiology
Paper Code: UBE03B03

Full Marks: 100

Time: 3 hours

STUDENTS ARE STRICTLY INSTRUCTED TO GIVE ANSWER SEPARATELY OF PART-I (50 Marks) AND PART-II (50 Marks) IN THE SAME ANSWER SCRIPT.

PART I

TOTAL MARKS (50)

ANSWER ANY FIVE QUESTIONS (10 Marks x 5 = 50 Marks):

1. a) Make a simple flow diagram of blood circulation in whole human body. 4
 - b) Explain the mode of action of steroid and polypeptide hormone? 6
 2. Sound wave propagates through the ear – Describe the propagation with anatomical details. 10
 3. a) Explain the reason of colour blindness and night blindness. 4
 - b) How Antidiuretic Hormone (ADH) maintains the water content in the body? What disease is developed due to deficiency of this hormone? 3
 - c) Why African Pygmies does not grow at normal rate? 3
 4. a) How stem cells differ from normal cells? 2
 - b) Write down the application of stem cells. 3
 - c) How glucose level is maintained in the blood? 2
 - d) Write down the advantages of peritoneal dialysis over hemodialysis. 3
 5. a) Glomerular Filtration Rate (GFR)? 2
 - b) What is Bowman's capsule? 2
 - c) If the concentration of a substance is 2.5 mg/ml in blood and 20 mg/ml in urine and urine is produced at 5ml/min, what is the clearance rate of the substance? (Assume the substance is neither reabsorbed nor secreted) 4
 - d) What is Tissue? Write down its divisions. 2
 6. Write a Short note (Any Five) 2 x 5 = 10
- (i) Diabetes Mellitus (ii) Cerebrovascular Accident (CVA) (iii) Coronary Bypass Surgery (iv) Cretinism
(v) Angioplasty (vi) Cataract Operation (vii) Pneumonia

PART-II

Total Marks (50)

Answer any five in the following.

1. Explain cell cycle/mitosis in detail with a neat diagram. (10 marks)
2. Explain how resting potential is maintained in the cells. (10 marks)
3. Explain depolarization, repolarization and hyperpolarization while highlighting the key differences among graded potential and action potential. (5+5=10 marks)
4. Explain the mechanisms how hydrophilic hormones are synthesized, secreted, transmitted to target cells and how it regulates the any activity in the human cells. (10 marks)
5. Explain the following: (2*5=10 marks)
 - a. Difference between neurotransmitters and neuropeptides
 - b. What is the fate of neurotransmitters released at the synaptic cleft? Explain with a neat diagram and the various events that take place.
6. Explain the different types of intercellular communications via chemical messengers (both direct and indirect) with a neat diagram and an example for each type. (10 marks)
7. Explain different types of active transport, passive transport and facilitated diffusion with examples. (10 marks)
8. Explain how cells yield their energy from glucose uptake. Show just the integrated pathways together that leads to energy generation. (10 marks)

The figures in the margin indicate full marks for the questions
 Candidates are required to give their answers in their own words as far as practicable

(Group-I & Group-II are compulsory)

GROUP-I

- A. Mark the correct answer only- (1 marks each): (1X10=10)
1. Which amino acid is INCORRECTLY matched to its side-chain?
 - a. lysine : ε-amino-aliphatic hydrocarbon chain
 - b. isoleucine : branched aliphatic hydrocarbon chain
 - c. tyrosine : aromatic imidazole
 - d. glutamic acid : δ-carboxylate-aliphatic hydrocarbon chain
 - e. methionine : γ-methylmercapto-aliphatic hydrocarbon chain
 2. Phosphorylation cascades involving a series of protein kinases are useful for cellular signal transduction because
 - a. they are species specific.
 - b. they always lead to the same cellular response.
 - c. they amplify the original signal many fold.
 - d. they counter the harmful effects of phosphatases.
 - e. the number of molecules used is small and fixed.
 3. Binding of a signaling molecule to which type of receptor leads directly to a change in the distribution of ions on opposite sides of the membrane?
 - a. receptor tyrosine kinase
 - b. G protein-coupled receptor
 - c. phosphorylated receptor tyrosine kinase dimer
 - d. ligand-gated ion channel
 - e. intracellular receptor
 4. One of the products in a transamination reaction is:
 - a. ketoacid
 - b. glycerol
 - c. ammonia
 - d. acetyl CoA
 5. The nitrogen-containing product of oxidative deamination is:
 - a. ammonium ion
 - b. carbamoyl phosphate
 - c. isopentenyl pyrophosphate
 - d. FADH₂
 6. The hormone that influences the production of red blood cells is:
 - a. thyroxin
 - b. erythropoietin
 - c. calcitonin
 - d. thymosin
 - e. insulin
 7. An example of an environmental signal that acts at a distance between individuals is
 - a. insulin
 - b. cortisol
 - c. pheromones
 - d. prostaglandins
 - e. nerve growth factor.
 8. The "fuel" for the urea cycle is:
 - a. ammonium ion,
 - b. bicarbonate ion,
 - c. carbamoyl phosphate,
 - d. acetyl CoA
 9. The citric acid cycle and the urea cycle are "linked" through the substance:
 - a. malate
 - b. fumarate
 - c. oxaloacetate
 - d. ornithine
 10. Adenylyl cyclase has the opposite effect of which of the following?
 - a. protein kinase,
 - b. protein phosphatase,
 - c. phosphodiesterase,
 - d. phosphorylase
 - e. GTPase

B. Answer the following questions (Any four) (4X5=20)

- A. Write in brief on the following topic (any two)
- a. Digestion of nucleic acids
 - b. Gout,
 - c. Nucleotide structure

- ✓ 2. Explain how an original signal molecule can produce a cellular response when it may not even enter the target cell.
 ✓ 3. Feedback inhibition is a common regulatory mechanism. Describe with example what feedback inhibition is and explain why it is an efficient system for regulating biochemical pathways.
 ✓ 4. Describe how the cytosolic concentration of Ca^{2+} can be altered and how the increased pool of Ca^{2+} is involved in signal transduction.
 5. Define zymogen and describe the role of one zymogen in protein digestion.

C. Answer the following questions (Any Five) (5X2=10)

- ✓ 1. What is/are the consequences of the activation of phospholipase C (PLC) by G protein mechanism?
 ✓ 2. What is the major end product of protein nitrogen metabolism in human?
 ✓ 3. Mention the name of an amino acid which contains a disulphide bond.
 ✓ 4. What is the name of the enzyme which is deficient in maple syrup urine disease?
 5. Is the tertiary structure of the 50 kD protein the same or different than the tertiary structure of the 250 kD protein? Explain briefly.
 6. What molecules serve as carriers of nitrogen?

D. Answer the following questions (2X5=10)

- ✓ 1. What is the (a) H^+ ion concentration, (b) OH^- ion concentration, (c) pH, and (d) pOH of a 0.001 M solution of HCl?
 ✓ 2. Calculate the standard free-energy changes of the following metabolically important enzyme-catalyzed reactions at 25°C and pH 7.0 from the equilibrium constants given.
 (a) Glutamate + oxaloacetate \leftrightarrow aspartate + α -ketoglutarate, $K_{\text{eq}}' = 6.8$
 (b) Dihydroxyacetone phosphate \leftrightarrow glyceraldehyde-3-phosphate, $K_{\text{eq}}' = 0.0475$
 (c) Fructose-6-phosphate + ATP \leftrightarrow F-1,6-bisphosphate + ADP, $K_{\text{eq}}' = 254$

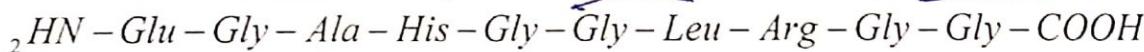
GROUP-II

Group II contains Part -I and Part II

Part-I (Compulsory)

20

- ✓ 1. The enzyme carboxypeptidase A catalyzes the hydrolysis of the following peptide in 10 mM phosphate buffer at pH 7. The enzyme is known to obey the Michaelis-Menten kinetics. Under this conditions of the experiment; $V_{\text{max}} = 10 \text{ mmol/min/mg}$ & $K_m = 0.2 \text{ mM}$



Name of Amino Acid	pK ₁	pK ₂	pK _R
Glu	2.2	9.7	4.3
Gly	2.4	9.8	-
Ala	2.3	9.7	-
His	1.8	9.2	6
Leu	2.4	9.6	
Arg	1.8	9	12.5

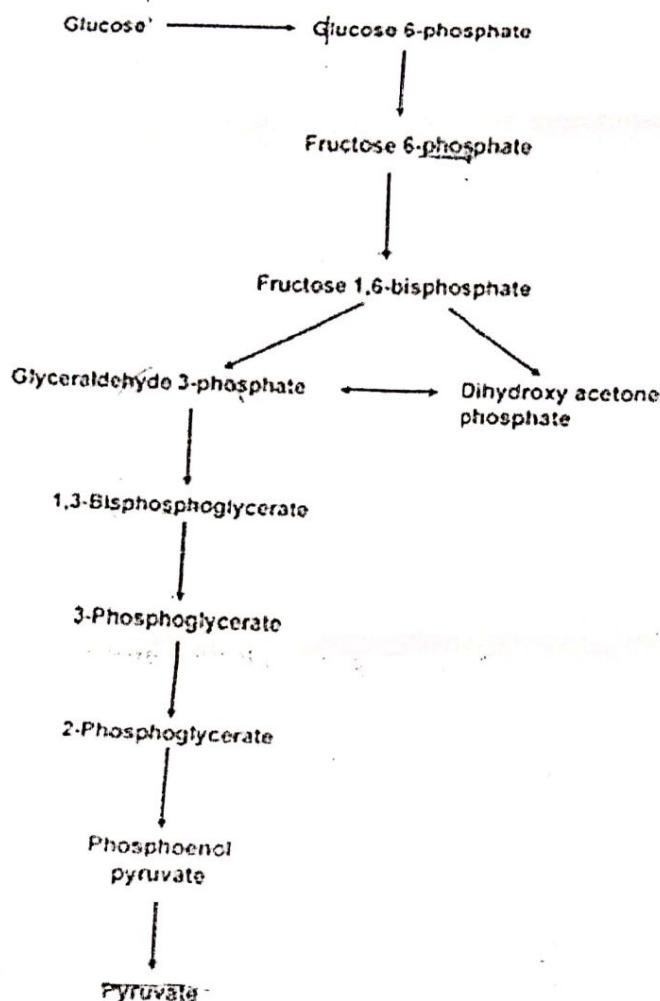
- i. Draw the fully protonated form of this peptide. 2
 ii. What is the overall charge of this peptide at pH 2? 4
 iii. Calculate the Isoelectric Point (pI) of this peptide? 2
 iv. Suppose that the substrate concentration of peptide in this assay is 500 μM . Calculate the expected initial velocity. 2
 v. Suppose another substrate was tested under the same condition at pH 7, and it was determined that K_m of this substrate for carboxypeptidase A was 5 mM. Which substrate has the higher affinity for carboxypeptidase A? 2

- vi. Draw a typical plot of V vs $[S]$ for this enzyme that follows MM kinetics. Level the axis and use the units as defined for V_{max} and K_m at the beginning of this question. 4
 vii. Draw a new graph showing how this plot changes when converted to a Lineweaver Burk Plot. Be sure to label the axis. Use the units as defined in the question. 4

Part-II (Any Two)

15X2=30

- ✓ Answer the following questions on glycolysis shown to the right:



- I. Place a BOX around the step(s) during which ATP is synthesized. 2
 II. CIRCLE the step(s) in which ATP is consumed. 1
 III. If appropriate, put STARS next to regulated steps. 1
 IV. If appropriate, put any symbol next to committed step 2
 IV. Glucose is eventually administered intravenously to patients as a food source. A new resident at a hospital where you are working suggests administering glucose-6-phosphate instead. You consider the possibility that this procedure might save the patient energy. Should you use the resident's suggestion? 1
 V. What is the NET yield of ATP made anaerobically in the conversion of 1 (mole) of glucose to pyruvate. (Do not include those generated from NADH). Give a number as your answer 1
 VI. How much equivalent amount of moles of ATP will be produced from Beta oxidation of 1 mol of palmitic acid (16:0) and 3 moles of glucose. Calculate production of equivalent amount of moles of ATP in each step. 6

A. Draw the different equilibrium equations of the ionization stages of the amino acid Glycine. Begin with the fully protonated form. [$R = -H$], ($pK_1 = 2.4$, $pK_2 = 9.8$)

- i. Calculate the pI. 2
- ii. Sketch a complete titration curve with structure in each step for glycine 3
- iii. Write down the importance of glycine and proline in 2D structure of protein. 2
- iv. Is glycine a chiral molecule give your justification 2
- B. Write down the classification of amino acids. 2
- C. How can you determine of purity of DNA with protein. Give your justification. 2
- D. Why BSA is used as standard molecule for protein determination? Would you expect the exact concentration of protein when protein contains high amount of tyrosine. 2

3. Short note on

(3X5=15)

(a) Reducing sugar and its determination, (b) Nomenclature of monosaccharide, (c) β -strands, (d) Enzyme regulation, (e) Vitamins B and D

B.Tech 3rd Semester End-Term Examination, 2018
Subject Name: Engineering Economics and Accountancy
Subject Code: UBE03C16

Full Marks: 100**Time: 3 hours***The figures in the margin indicate full marks for the questions***Answer all the questions**

1. a) Define indifference curve.
 b) Explain the following:
 - i. Indifference Curves Slope from left downward to right.
 - ii. Higher indifference curve represents higher level of satisfaction.
 c) Explain the consumer's equilibrium under cardinal approach graphically as well as mathematically. (2+2+2+4=10)
2. a) Discuss the various types of cross elasticity of demand.
 b) Distinguish between elastic demand and inelastic demand.
 c) Explain the various factors of production. (4+2+4=10)
3. a) Define: i) Iso-quant. ii) Iso-cost line.
 b) Prove the followings:
 - i) In Cobb-Douglas production function marginal productivities of labour and capital depend on the ratio of the two factors.
 - ii) The elasticity of substitution for the Cobb-Douglas production function is equal to unity. (2+2+3+3=10)
4. a) Explain the different types of returns to scale with the help of suitable diagram.
 b) Discuss the law of variable proportion graphically.
 c) Distinguish between fixed cost and variable cost. (4+4+2=10)
5. a) Obtain the maximum output that the firm can produce by incurring a cost of Rs.100 whose production function is given as $Q=X_1^{1.5}X_2$. The unit prices of the two inputs used X_1 and X_2 are respectively Rs.3 and Rs.4.
 b) The MC function of manufacturing X shoes is $6+10X-6X^2$. The total cost of producing a pair of shoes is Rs.19. Find the TC and AC.
 c) Explain how long run average cost curve is derived from short run average cost curves. (3+3+4=10)
6. a) What is the shape of AFC curve?
 b) Why is the MC curve of U shape?
 c) The cost equation of the firm is given by $C=5x_1+10x_2$ while the production function is given by $q=x_1x_2$. Find the minimum cost of producing 50 units of output.
 d) Given the total cost function $C=15q-6q^2+q^3$. Derive the equations of AC and MC curves. (2+3+3+2=10)

(5)

✓ "All transactions are event but all events are not transaction"- Discuss.

(2+2=4)

✓ Write notes on: (i) Double entry system (ii) Nominal Account

✓ Define Cash Book.
From the following transactions Prepare a Double Column Cash Book in the books of Way2Electricals Ltd:

01.03.18	Cash Balance	Rs. 200,000
	Bank Balance	Rs. 160,000
02.03.18	Purchased a Machine	for Rs. 20,000
04.03.18	Purchased goods	for cash Rs. 10,600
06.03.18	Rent paid	Rs. 10,000
12.03.18	Deposited cash	into bank Rs. 30,000
15.03.18	Goods sold	for cash Rs. 20,200
18.03.18	Withdrawn cash	from Bank Rs. 4,000
26.03.18	Received a cheque	from Mr. P for Rs. 5,400 and immediately deposited to the bank

28.03.18 Above cheque dishonoured by bank.

(2+8=10)

✓ 10. (a) Define Depreciation. What are its causes?

Jaypee Pvt. Ltd Purchased a machine on 1st January 2014 for Rs.1,00,000 and spent Rs 5,000 for installation charges. The estimated effective useful life of the machine was three years and estimated scrap value was Rs. 12,000. On 31st December 2016 the machine was sold for Rs.18,000 and on the same date another machine was purchased for Rs. 1,00,000.

Assume books of account close on 31st December every year. Show machine Account and Depreciation for the same period.

(2+2+5+3=12)

✓ 11. From the following data calculate total monthly remuneration of each of the workers.

(i) Standard production per worker is 2,000 units.

(ii) Actual production during a month: A-1780 units, B-1480 units and C-1900 units.

Basic piece work rate per unit is Rs.20, Dearness wages Rs.1000 per month, House rent allowance is Rs.500 per month and Tiffin allowance is Rs.500 per month.

Additional production bonus @ Rs.60 for each percentage of actual production exceeding 80% of standard.

(9)

Full Marks: 100

Time: 3 hours

Both Part-I and part -II are compulsoryPart-I: Attempt ALL questions

✓ 1) What is the chemical potential of an ideal gas at 10 atm and 10°C assuming standard chemical potential is 100 J/mole? [2 marks]

2) What is the activity of pure nitrogen gas at 0.001 atm? [2 marks]

3) Decide whether the following statements are true or false: [2x2=4 marks]

(a) For an irreversible adiabatic expansion, the pressure and volume of an ideal gas are related as: $PV^\gamma = \text{constant}$ where symbols have their usual meanings.

(b) Biological reactions are often catalyzed by specific enzymes. This is because enzymes can decrease the free energy of products.

✓ 4) Suppose that a reversible reaction has $\Delta H = -28 \text{ kJ}$ and $\Delta S = -60 \text{ J/K}$. Which of the following statement is true? a) At 467K, system remains at equilibrium, b) At 500K, backward reaction is spontaneous, c) At 400K, forward reaction is spontaneous, d) All of the above. [2 marks]

✓ 5) Consider heating of a solution M having 25 mole % "A" and 75 mole % "B". Boiling point of pure "A" is 80°C and pure "B" is 100°C. Draw a typical T-xy plot to show following items in the plot: (i) bubble point curve, (ii) dew point curve, (iii) the boiling point of the solution M, (iv) vapor composition at the boiling point of M (v) boiling point of last drop of the solution. [5x2=10 marks]

Part-II: Attempt any FOUR questions

✓ 1) Consider the metabolism of glucose in the human body that breathes in air at 25°C and exhales a mixture of CO₂, H₂O, O₂, and N₂ at 37°C. Assume that there is a steady supply of glucose to the human body at 25°C, and the air consumed is 5 times higher than its theoretical requirement. Also assume that no shaft work is involved. If the inhalation occurs at a rate of 360 L/hr, determine the rate of heat loss from the human body. Assume air contains 21% oxygen and 79% nitrogen by volume.

Data given:

[20 marks]

	Glucose	CO ₂	H ₂ O	O ₂	N ₂
h _r ^o (kJ/mol)	-1.26x10 ³	-393.5	-241.8		
C _p (J.mol ⁻¹ K ⁻¹)		36.92	33.17	29	28.75

✓ 2) (a) Draw and explain a typical P-xy plot for liquid-vapor equilibrium in a binary solution at a given temperature. [4 marks]

(b) Derive the equation of the bubble point and dew point curve of the P-xy plot assuming an ideal binary solution. [8 marks]

✓ (c) A sealed can of carbonated beverage (assume it as a mixture of CO₂ and water) contains 1% (mole) CO₂ at 10°C. Find out the total pressure inside the can and vapor phase composition. Given: Henry's constant for CO₂ in water at 10°C is 990 bar and vapor pressure of pure water at 10°C is 0.012 bar. [6 marks]

(d) What is Clausius inequality? [2 marks]

3) (a) Under biochemical standard conditions, aerobic respiration produces approximately 38 molecules of ATP per molecule of glucose that is completely oxidized. (i) What is the percentage efficiency of aerobic respiration under biochemical standard conditions? (ii) The following conditions

are more likely to be observed in a living cell: $p\text{CO}_2 = 0.053 \text{ atm}$, $p\text{O}_2 = 0.132 \text{ atm}$, $[\text{glucose}] = 5.6 \times 10^{-2} \text{ M}$, $[\text{ATP}] = [\text{ADP}] = [\text{Pi}] = 1.0 \times 10^{-4} \text{ M}$, $\text{pH} = 7.4$, $T = 310 \text{ K}$. What is the percentage efficiency of aerobic respiration under these physiological conditions? (iii) A typical diesel engine operates between 873 K and 1923 K with an efficiency that is approximately 75 per cent of the theoretical limit. Compare the efficiency of a typical diesel engine with that of aerobic respiration under typical physiological conditions. (iv) Why is biological energy conversion more or less efficient than energy conversion in a diesel engine? [5+8+2+2=17 marks]

Data Given:

	Combustion of glucose	Hydrolysis of ATP into ADP, Pi and H_3O^+
Standard Gibbs free energy of reaction (kJ/mole)	-2880	+11

(b) What is statistical entropy? [3 marks]

4) (a) With the gradual increase in the temperature, a solution of dsDNA separates into its component ssDNA oligos due to thermal denaturation or melting. Considering thermodynamic equilibrium of denaturation reaction at a given temperature, derive a relation to express temperature (T) of the solution as a function of the following variables: total concentration of DNA strands (C_T), fraction of total DNA that is double stranded (f), and the thermodynamic parameters (ΔH° and ΔS°). Apply this relation to find out the melting point (T_m) of the DNA where the melting temperature is defined to be the point where half of the dsDNA is denatured. [8 marks]

(b) Determine the equilibrium constant for self-ionization of water. Show that the pH of neutral water at 25°C is 7.0. Also calculate the pH of neutral water at its normal boiling point. [4+4+4 = 12 marks]

Data Given:

(i) Standard enthalpy for ionization of water = 57 kJ/mol

(ii) other data:

	H_2O	OH^-
Standard Gibbs free energy of formation (kJ/mole)	-157.29	+237

5. Write a short note on each of the following items: a) Maxwell relation, b) Reversible change of state, c) Fugacity, d) Activity [4x5=20 marks]

Enrolment No. 17UR8603

S₃(All Branch): ALL

B. TECH 3rd SEMESTER END-TERM EXAMINATION – 2018

Subject Name: Engineering Mathematics – III

Subject code: UCH/CE/PE03C14/UCS/EC/EE/EI03C13/UME03C12

Full Marks: 100

Time: 3 Hours

Symbols used here have their usual meanings

Group A

Answer any five of the following questions

Marks: $5 \times 10 = 50$

1/ Three newspapers A, B and C are published in a certain city. It is estimated from a survey that of the adult population: 20% read A, 16% read B, 14% read C, 8 % read both A and B, 5% read both A and C, 4% read both B and C, 2% read all three. Find what percentage read at least one of the papers.

✓ 2/ A vessel containing 3 white and 5 black balls, 4 balls are transferred into an empty vessel. From this vessel a ball is drawn and is found to be white. What is the probability that out of four balls transferred 3 white and 1 is black?

✓ 3. In a continuous distribution whose relative frequency density is given by:
 $f(x) = y_0\{x(2-x)\}, 0 \leq x \leq 2$, find the mean, variance and mode of the distribution and also show that for the distribution $\mu_{2n+1} = 0$.

✓ 4/ A multiple choice test consists of 8 questions with 3 answers to each question (of which only one is correct). A student answers each questions by rolling a die and checking the first answer if he gets 1 or 2, the second answer if he gets 3 or 4 and the third answer if he gets 5 or 6. To get a distinction, the student must secure at least 75% correct answer. If there is no negative marking, what is the probability by using Binomial Distribution that the student secures a distinction?

5. In a book of 520 pages, 390 typographical errors occur. Assuming Poisson law for the number of errors per page, find the probability that a random sample of 5 pages will contain no error.

✓ 6/ The random variable X and Y are jointly normally distributed and U and V are defined by
 $U = X\cos\alpha + Y\sin\alpha, V = Y\cos\alpha - X\sin\alpha$.

Show that U and V will be uncorrelated if

$$\tan 2\alpha = \frac{2r\sigma_x\sigma_y}{\sigma_x^2 - \sigma_y^2}$$

Where $r = \text{corr.}(X, Y)$; $\sigma_x^2 = \text{Var}(X)$ and $\sigma_y^2 = \text{Var}(Y)$. Are U and V independent?

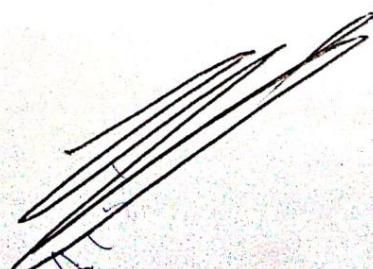
✓ 7. In a partially destroyed laboratory, records of an analysis of correlation data, the following results only are legible:

Variance of $X = 9$; Regression equations: $8X - 10Y + 66 = 0$ and $40X - 18Y = 214$.

What are (i) the mean values of X and Y ,

(ii) the correlation coefficient between X and Y ,

(iii) the standard deviation of Y .



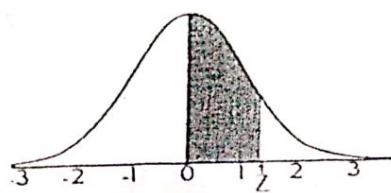
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- ✓ 8. The variables X and Y are connected by the equation $aX + bY + c = 0$. Show that the correlation between them is -1 if the sign of a and b are alike and $+1$ if they are different.
- ✓ 9. Establish the Poisson distribution from the Binomial distribution.
10. The local authorities in a certain city install 10,000 electric lamps in the streets of the city. If these lamps have an average life of 1,000 burning hours with a standard deviation of 200 hours, assuming normality what number of lamps might be expected to fail (i) in the first 800 burning hours? (ii) between 800 and 1,200 burning hours? After what period of burning hours would you expect that 10% of the lamps would fail?

Group B
Answer all the following questions

Marks: 50

1. (a) Define Homogeneous and Non-homogeneous linear equation with constant co-efficient along with suitable examples.
 (b) Solve: $(D^2 - 3DD' + 2D'^2)z = e^{2x-y} + e^{x+y} + \cos(x + 2y)$. [4+6]
2. (a) Find the half range cosine series for $f(x) = \left(-\frac{x}{l}\right) + 1$, $0 \leq x \leq l$.
 (b) Find a complete integral of $yzp^2 - q = 0$. [5+5]
3. (a) Solve: $(3x + y - z)p + (x + y - z)q = 2(z - y)$.
 (b) Find the complete integral of $pq = px + qy$. [5+5]
4. (a) Find the Fourier series of $f(x) = \begin{cases} -\frac{\pi+x}{2}, & -\pi < x < 0 \\ \frac{\pi-x}{2}, & 0 < x < \pi \end{cases}$
 (b) Solve: $(D^2 + DD' - 6D'^2)z = x^2 \sin(x + y)$. [4+6]
5. (a) Form a partial differential equation by eliminating the function f from $z = x^n f(\frac{y}{x})$.
 (b) An insulated rod of length l has its ends A and B maintained at 0°C and 100°C respectively until steady state conditions prevail. If the temperature at B is suddenly reduced to 0°C and kept so while that of A is maintained at 0°C , find the temperature at a distance x from A at any time t . [3+7]



STANDARD NORMAL TABLE (Z)

Entries in the table give the area under the curve between the mean and z standard deviations above the mean. For example, for $z = 1.25$ the area under the curve between the mean (0) and z is 0.3944.

	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0190	0.0239	0.0279	0.0319	0.
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.
0.8	0.2881	0.2910	0.2939	0.2969	0.2995	0.3023	0.3051	0.3078	0.3106	0.
0.9	0.3159	0.3186	0.3212	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3513	0.3554	0.3577	0.3599	0.
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.
2.0	0.4772	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.
2.2	0.4861	0.4864	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.
2.9	0.4981	0.4982	0.4982	0.4983	0.4984	0.4984	0.4985	0.4985	0.4986	0.
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.
3.1	0.4990	0.4991	0.4991	0.4991	0.4992	0.4992	0.4992	0.4992	0.4993	0.
3.2	0.4993	0.4993	0.4994	0.4994	0.4994	0.4994	0.4994	0.4995	0.4995	0.
3.3	0.4995	0.4995	0.4995	0.4996	0.4996	0.4996	0.4996	0.4996	0.4996	0.
3.4	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.4997	0.