L-2/T-2/EEE **Date: 27/03/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2019-2020

Sub: **EEE 205** (Energy Conversion II)

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) Derive an expression for generated voltage in the fractional-pitched armature winding of a synchronous generator. Draw qualitatively the wave shapes of line voltages of a three-phase generator with full-pitch and fractional-pitch windings. **(15)**

(b) What are slot harmonics? How can they be reduced? **(8)**

(c) A three-phase four-pole winding of the double-layer type is to be installed on a 48-slot stator. The pitch of the stator windings is 5/6, and there are 10 turns per coil in the windings. All coils in each phase are connected in series, and the three phases are connected in Δ. The flux per pole in the machine is 0.054 Wb, and the speed of rotation of the magnetic field is 1800 r/min. **(12)**

(i) What is the pitch factor of this winding?

(ii) What is the distribution factor of this winding?

(iii) What is the frequency of the voltage produced in this winding?

(iv) What are the resulting phase and terminal voltages of this stator?

2. (a) Develop the equivalent circuit of a salient pole synchronous generator. **(12)**

(b) How can the real power sharing between two generators be controlled without affecting the system's frequency? How can the reactive power sharing between two generators be controlled without affecting the system's terminal voltage? How can the system frequency of a large power system be adjusted without affecting the power sharing among the system's generators? **(12)**

(c) A 2300-V 1000-kVA 0.8-PF-lagging 50-Hz two-pole Y-connected synchronous generator has a synchronous reactance of 1.1 Ω and an armature resistance of 0.15 Ω. At 50 Hz, its friction and windage losses are 24 kW, and its core losses are 18 kW. The field circuit has a dc voltage of 200 V, and the maximum I_F is 10 A. The resistance of the field circuit is adjustable over the range from 20 to 200 Ω. The OCC of this generator is shown in Figure 2(c). **(11)**

(i) How much field current is required to make V_T equal to 2300 V when the generator is running at no load?

(ii) What is the internal generated voltage of this machine at rated conditions?

Contd P/2

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Contd... Q. No. 2(c)

(iii) How much field current is required to make V_T equal to 2300 V when the generator is running at rated conditions?

(iv) How much power and torque must the generator's prime mover be capable of supplying?

Fig. 2(c)

3. (a) A 480-V 400-kVA 0.85-PF-lagging 50-Hz four-pole Δ-connected generator is driven by a 500-hp diesel engine and is used as an emergency generator. This machine can also be paralleled with the normal power supply (a very large power system) if desired. **(20)**

(i) What are the conditions required for paralleling the emergency generator with the existing power system?

(ii) If the generator is connected to the power system and is initially floating on the line, sketch the resulting phasor diagram.

(iii) The governor setting on the diesel engine is now increased. Show both by means of house diagrams and by means of phasor diagrams what happens to the generator. Does the generator supply reactive power now?

(iv) With the emergency generator now supplying real power to the power system, what happens to the generator as its field current is increased and decreased? Show this behaviour both with phasor diagrams and with house diagrams.

(b) Discuss the problem of synchronous motor starting and the basic approaches to solve the problem. **(15)**

Contd P/3

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4. (a) A synchronous motor is operating at a fixed real load, and its field current is increased. If the armature current falls, was the motor initially operating at a lagging or a leading power factor? Why must the voltage applied to a synchronous motor be derated for operation at frequencies lower than the rated value? **(13)**

(b) Explain, using phasor diagrams, what happens to a synchronous motor as its field current is varied. Derive a synchronous motor V curve from the phasor diagram. **(12)**

(c) A 400-V, 50 Hz, four-pole synchronous motor draws 50 A from the line at unity power factor and full load. Assuming that the motor is lossless, answer the following questions: **(10)**

(i) What must be done to change the power factor to 0.8 leading? Explain your answer, using phasor diagrams.

(ii) What will the magnitude of the line current be if the power factor is adjusted to 0.8 leading?

SECTION – B

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

All the symbols have their usual meanings. Assume reasonable values for missing data.

5. (a) "Single phase induction motor doesn't have any internal torque at starting but somehow if it is brought up to some speed, then torque will develop and it can keep running" — Justify the statement using Double-Revolving-Field Theory. **(15)**

(b) A 250-V 210-A shunt dc motor with an armature resistance of 0.06 Ohm and the shunt field resistance of 25 Ω is desired to design a starter circuit for this motor which will limit the maximum starting current to 3 times its rated value **(20)**

(i) Find the number of stages and value of resistance at each state?

(ii) Draw the armature current vs. time with proper labelling.

6. (a) A twelve-pole, 30-hp, 220-V dc machine has 96 coils with 10 turns per coil. Calculate the number of parallel current path and current that will flow in each path at rated conditions if the armature is **(12)**

(i) duplex lap-wound, (ii) triplex wave-wound, (iii) quadruplex lap-wound

(b) A 120-V series dc motor having an armature resistance of 0.1 ohm and a series field resistance of 0.08 ohm is operating with the input current of 60 A at 1050 r/min. The core losses are 220 W, and the mechanical losses are 230 W. [assume that magnetic flux is proportional to field current, $\Phi \alpha I_F$] **(10)**

(i) What is the motor efficiency?

(ii) What will be new speed and copper loss if the input current in doubled?

Contd P/4

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Contd... Q. No. 6

(c) A 100-hp, 250-V compounded dc motor with compensating windings has $R_A+R_S = 0.04$ Ohm and no-load speed 1200 rpm. There are 2000 turns per pole on the shunt field and 10 turns per pole on the series winding. **(13)**

Find the motor speed if the armature current $I_A = 150$ A when the motor is

(i) Cumulatively compounded

(ii) Differentially compounded

[magnetization curve is shown in Figure for Q.6(c)]

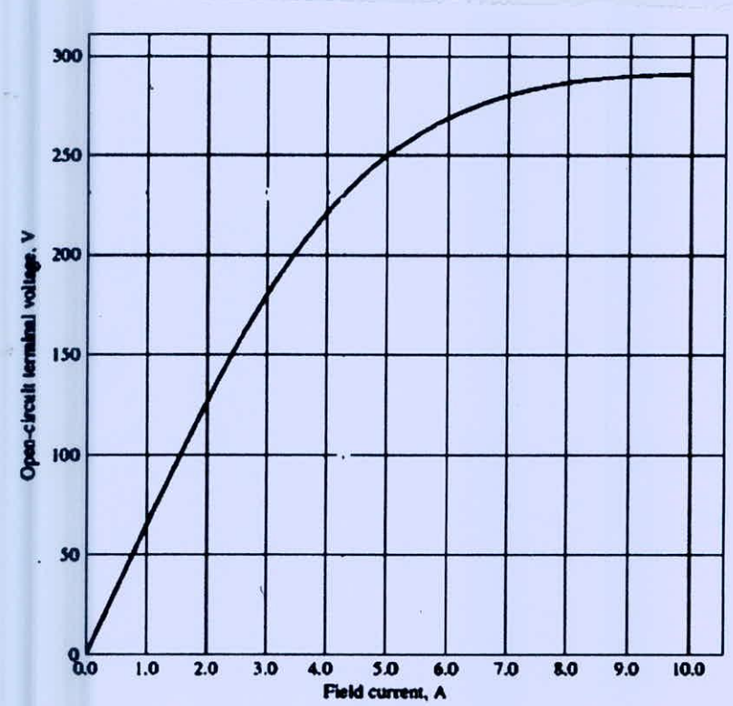

Figure for Q.6(c)

7. (a) What is the effect of "$L\frac{di}{dt}$ voltages" problems in DC machines? Describe how this problem can be solved? **(13)**

(b) Describe step by step (cause and effect summary) how speed of a DC shunt motor can be decreased using flux control method? [show necessary equation and circuit diagram] **(9)**

(c) A 1200 rpm shunt DC motor with the shunt field current $I_F = 0.7$ A, armature resistance, $R_A = 0.35\ \Omega$ is applied a terminal DC voltage of $V_T = 280$ V. If the shunt current is decreased by 10%, what will be percentage change in field resistance R_F and in induced torque τ_{ind}? [magnetization curve is shown in Figure for Q.7(c)] **(13)**

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Contd... Q. No. 2

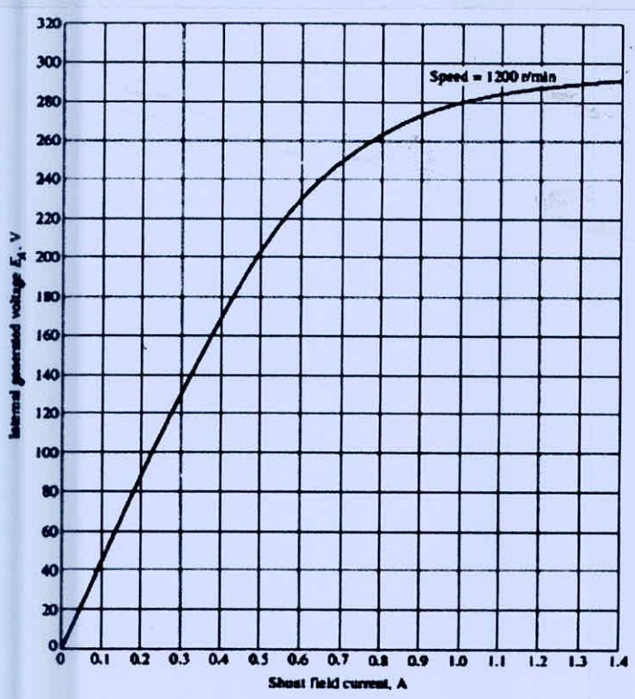

Figure for Q.7(c)

8. (a) A 220-V, 1.5-hp, 50-Hz, two-pole, capacitor-start single phase induction motor has the following main-winding impedances: **(15)**

$R_1 = 1.40$ ohm, $R_2 = 1.50$ ohm

$X_1 = 1.90$ ohm, $X_2 = 1.90$ ohm

$X_M = 100$ ohm

At a slip of 0.05, the motor's rotational losses are 291 W [assume constant rotational loss]. Find the stator current and overall motor efficiency.

(b) What is MPPT controller? Draw and explain the block diagram of typical solar energy system? **(10)**

(c) Consider a Silicon solar cell operating at 300 K temperature. The diode ideality factor of the cell is 1, solar irradiation condition is Iph = 15 mA and it has a reverse saturation current of Is = 50×10^{-9} A. **(10)**

Calculate the change in open circuit voltage V_{OC} and short circuit current I_{SC} if the temperature is doubled and solar irradiation condition is halved.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2019-2020

Sub : **EEE 207** (Electronics Circuits II)

Full Marks : 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

All symbols have their usual meanings. Assume reasonable values for missing data.

SECTION – A

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

1. (a) Draw the block diagrams of four different feedback topologies, including the type of basic amplifier and the expression of feedback factor. Also draw the equivalent circuit of the basic amplifiers. **(16)**

   (b) Calculate the voltage gain, A_{vf}, input resistance R_{if} and output resistance (including load) R'_{of} for the circuit shown in Fig. for Q. 1(b). Given that V_{DD} = 12 V, g_m = 5 mA/V, $r_d = \infty$, R_D = 5.1 kΩ, R_s = 1 kΩ, and R_F = 20 kΩ. **(19)**

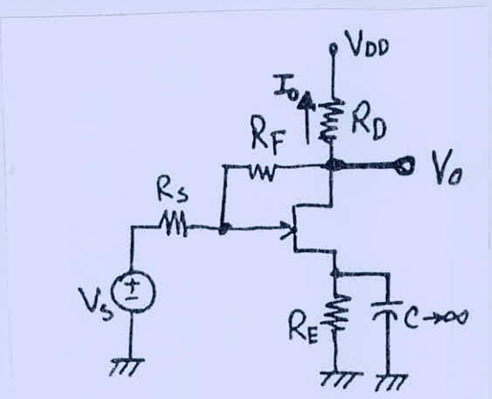

Fig. for Q. 1(b)

2. (a) The high frequency response of an amplifier is given by, **(10)**

$$F_H(s) = \frac{\left(1 + s/4\times10^4\right)\left(1 - s/10^5\right)}{\left(1 + s/10^4\right)\left(1 + s/2\times10^4\right)\left(1 + s/10^6\right)}$$

   Using the approximate equation, determine the higher cut-off frequency, ω_H. Also, determine whether the 'dominant pole' approximation is valid in this case?

   (b) Sketch Bode plot for the magnitude and phase of the following transfer function.

$$T(s) = \frac{10^5 s\left(10^4 + s\right)}{\left(10 + s\right)\left(10^3 + s\right)^2}$$

   From the plot, estimate the approximate magnitude and phase at $\omega = 10^6$ rad/s. **(15)**

   (c) Using the equivalent circuit for high frequency response and approximate method based on Miller's effect, find the upper-3dB frequency f_H of the common source amplifier circuit as shown in Fig. for Q. 2(c). Given that R_S = 80 kΩ, R_L = 10 kΩ, g_m = 4 mA/V, r_d = 10 kΩ and $C_{gs} = C_{sd}$ = 1 pF. **(10)**

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Contd ... Q. No. 2(c)

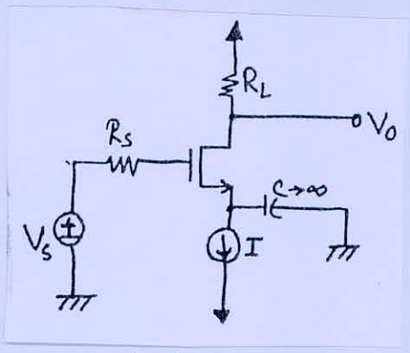

Fig. for Q. 2(c).

3. (a) For a Class–A transformer coupled amplifier, derive the expression of current gain, A_i and input resistance, R_{in} as **(13)**

$$A_i \approx \frac{R_B}{\frac{R_B}{\beta} + R_E} \qquad \text{and} \qquad R_{in} = \beta R_E \,||\, R_B$$

where, symbols have their usual meaning.

(b) A Class–A transformer-coupled power amplifier must deliver an output of 0.5 W to an 8–Ω speaker. What transformer ratio is needed to provide this power if V_{CC} = 18 V? The transistor has V_{BE} = 0.7 V and β = 100. Assume zero resistance in the transformer. What transformer. What transistor power rating is needed? **(12)**

(c) Derive the expression for the power rating of each transistor for class-B push-pull amplifier. **(10)**

4. (a) Design a 3rd order bandpass filter with a resonant frequency of 1000 Hz and a bandwidth of 3000 Hz. Consider the minimum value of capacitor as 0.1 μF. **(10)**

(b) Determine which of the following signal(s) will pass through the filter shown in Fig. for Q. 4(b). **(10)**

(i) 4 sin (30πt) (ii) 2 sin (20πt) (iii) 5 sin (100πt). Give your reason.

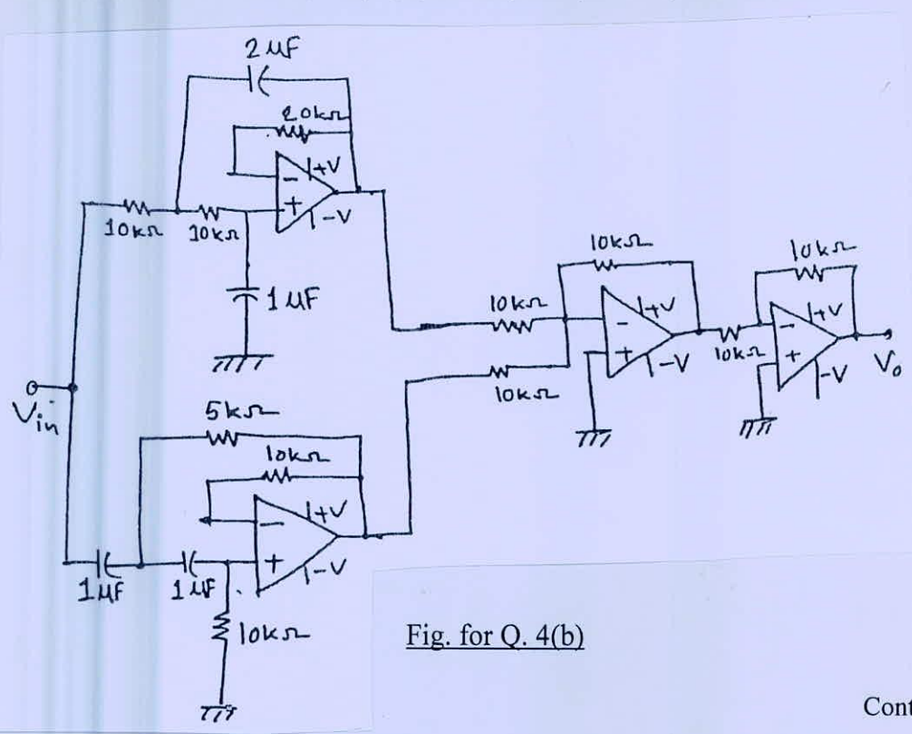

Fig. for Q. 4(b)

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Contd ... Q. No. 4

(c) Determine the type of filter and the cut-off frequency for the circuit shown in Fig. for 4(c). [Hint: Determine the transfer function of the system] **(15)**

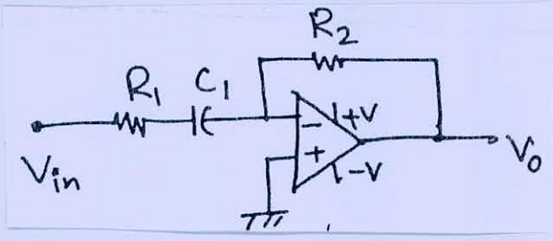

Fig. for 4(c)

SECTION – B

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

5. (a) Explain the operation and deduce the equation of closed-loop gain of an OP-AMP inverting amplifier with necessary diagram. **(15)**

(b) Derive an expression for the voltage gain v_o/v_I of the circuit shown in Fig. for Q. 5(b). Design the circuit to have an input resistance of 100 kΩ and a gain that can be varied from –1 V/V to – 10 V/V using the 10 kΩ potentiometer R_3. What voltage gain results when the potentiometer is set exactly at its middle value? **(20)**

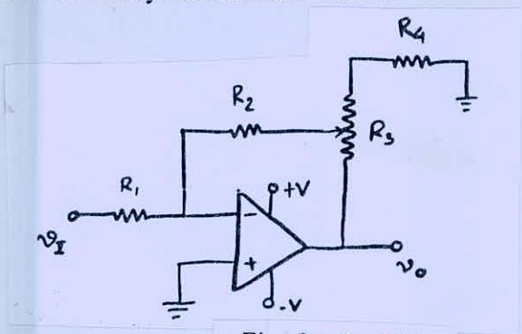

Fig. for Q. 5 (b)

6. (a) Design a circuit using OP-AMP that can give solution to the following equation.

$$5\frac{d^3v}{dt^3}+3\frac{d^2v}{dt^2}-2v+3=0$$

Briefly discuss the operation of your designed circuit. **(17)**

(b) The switch was closed at t=0s and opened at t=0.25 s in the circuit shown in Fig. for Q. 6(b). Derive the equation of the output voltage, V_o. Also, draw the waveform of V_o. Given, $+V_{sat}$=14 V and $-V_{sat}$= - 13.5 V. **(10)**

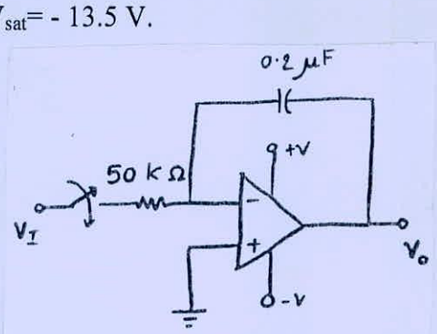

Fig. for Q. 6(b)

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Contd ... Q. No. 6(c)

(c) Describe the design procedure for nulling-out the effect of offset voltage and bias currents. **(8)**

7. (a) Derive the expressions of the upper threshold voltage, V_{UT} and lower threshold voltage, V_{LT} in terms of m, V_{ref}, + V_{sat}, and – V_{sat} for the comparator circuit shown in Fig. for Q. 7(a). Also, deduce the equation of center voltage, V_{ctr}. Design the circuit such that V_{UT} = 15 V and V_{LT} = 9 V. Draw the transfer characteristics of your designed circuit. Assume that $\pm V_{sat} = \pm$ 18 V. **(18)**

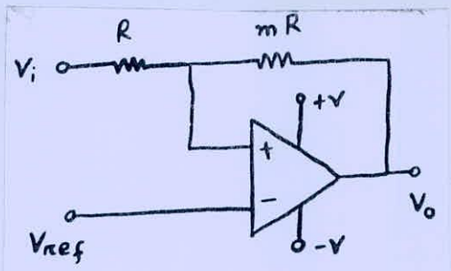


Fig. for Q. 7 (a)

(b) A 741 OP-AMP in the circuit of Fig. for Q. 7(b) has following drift specifications. As temperature changes from 20°C to 80°C, input offset current changes by a maximum of 0.2 nA/°C and input offset voltage changes by a maximum of 18 μV/°C. Assume that output voltage, V_o was zeroed at 20°C. If the surrounding temperature increases to 70°C, find (i) the maximum error in V_o due to drift in input offset current, (ii) the maximum error in V_o due to drift in input offset voltage, and (iii) worst possible change in V_o due to drift. **(17)**

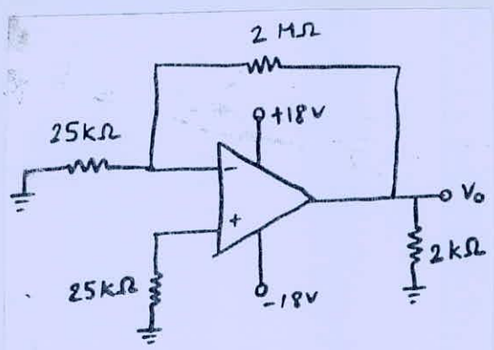


Fig. for Q. 7 (b)

8. (a) Design a free-running multivibrator circuit using 555 IC that has 2 kHz frequency of oscillation and 50% duty cycle. **(10)**

(b) For Wien bridge oscillator with OP-AMP based amplifier, derive the equation of frequency of oscillation. Deduce the condition on amplifier gain for which oscillation will sustain. **(17)**

(c) Design a Hartley oscillator that oscillates at 100 kHz frequency using an OP-AMP. Make necessary assumptions. **(8)**

L-2/T-2/EEE **Date : 07/04/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2019-2020

Sub : **ME 267** (Mechanical Engineering Fundamentals)

Full Marks : 210 Time : 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks.

Assume reasonable values for missing data. All symbols used to have their usual meanings.

SECTION – A

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

1. (a) Why diesel cannot be used in petrol engine? **(7)**

   (b) How does the thermal efficiency of an ideal Otto cycle change with the compression ratio of the engine and the specific heat ratio of the working fluid? **(8)**

   (c) An ideal Otto cycle has a compression ratio of 7. At the beginning of the compression process, air is at 0.1 MPa and 35°C, and 504.8 kJ/kg of heat is transferred to air during the constant-volume heat-addition process. Using specific heat value at room temperature, determine (a) the temperature and the pressure at various points in the cycle, (b) work done per kg of air, (c) the cycle efficiency. The properties of air at room temperature are c_p = 1.005 kJ/kgl·K, c_v = 0.718 kJ/kg·K, R = 0.287 kJ/kg·K, and k = 1.4. **(20)**

2. (a) With the help of a schematic diagram briefly explain how a petrol engine ignition system works. **(10)**

   (b) A 4 liter SI V8 engine that operates on a four-stroke cycle at 4000 RPM. The compression ratio is 10. The engine is square (stroke length = cylinder bore). Calculate cylinder bore, stroke length, average piston speed, clearance volume of one cylinder. **(15)**

   (c) Explain why the water tubes of Babcock and Wilcox boiler are kept inclined. **(10)**

3. (a) "Boiler accessories are devices that are installed to improve the overall efficiency of the boiler plant", justify the statement. **(15)**

   (b) Write short notes on **(20)**

   (i) Ocean thermal Energy Conversion (OTEC)

   (ii) Solar photovoltaics

4. (a) What are the functions of an air handling unit in central air conditioning system? Illustrate with necessary schematic diagram. **(15)**

   (b) How does an absorption refrigeration system differ from a vapor-compression refrigeration system? **(15)**

   (c) Air enters a window air conditioner at 1 atm, 30°C, and 80 percent relative humidity at a rate of 10 m^3/min, and it leaves as saturated air at 14°C. Part of the moisture in the air that condenses during the process is also removed at 14°C. Determine the rates of heat and moisture removal from the air. The enthalpy of saturated liquid water at 14°C. is 58.8 kJ/kg. **(15)**

Contd P/2

ME 267

SECTION – B

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

5. (a) State 'First' and 'Second' Laws of Thermodynamics. Explain how these two laws quantity 'energy' and 'efficiency' of a system with references to PMM1 and PMM2. **(16)**

   (b) What is Entropy? How does the entropy of a closed isolated system change? **(9)**

   (c) An inventor has designed a heat engine which works between a source temperature of 327°C. and a sink temperature of 27°C. The inventor claims that the heat engine can produce a work output of 300 kJ with a heat input of 500 kJ. Is the claim of the inventor true? – Justify. **(10)**

6. (a) Illustrate the processes for improving the thermal efficiency of a standard Rankine Cycle. **(10)**

   (b) What is 'cogeneration'? Draw the block diagram of a standard Gas-Stream combined cycle powerplant and show the corresponding thermodynamic processes involved in the cycle in a T-s diagram. **(13)**

   (c) Stream power plant operates between a boiler saturation temperature of 180°C and condenser temperature of 45°C. Dry saturated steam enters the turbine. Calculate its thermal efficiency. Use the data below: **(12)**

T	p	v_f	v_s	s_f	s_{fg}	s_g	h_f	h_{fg}	h_g
[°C]	[kPa]	[m³/kg]		[kg/kg.K]			[kJ/kg]		
45	95.8	0.0010	15.28	0.638	7.515	8.163	188	2394	2582
180	1000.0	0.0011	0.1944	2.14	4.45	6.59	763	2015	2778

7. (a) Differentiate pump, fan, blower and compressor. **(12)**

   (b) What is 'critical radius of insulation'? Derive its expression for the insulation of a cylindrical pipe. **(13)**

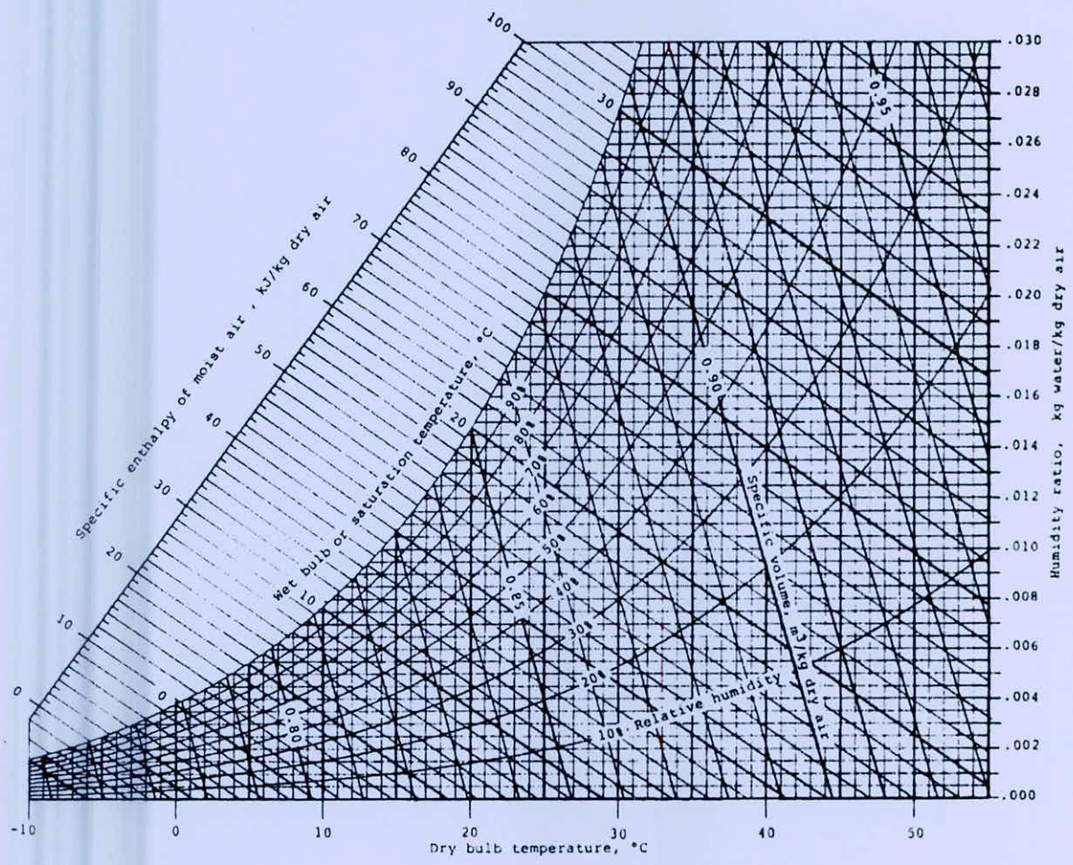
   (c) A furnace wall of thickness 1.5 m and of surface area 10 m^2 is made of a material whose thermal conductivity is 1.0 W/m°C. The temperatures of the inner and outer surfaces of the furnace wall are 1100°C and 50°C, respectively. Determine the rate of heat transfer through the wall. **(10)**

8. (a) Differentiate between (i) 'uniform flow' vs. 'steady flow' and (ii) laminar flow' vs. 'turbulent flow'. **(10)**

   (b) Explain why priming is needed in a centrifugal pump. Draw the typical characteristics curves of a centrifugal pump. **(13)**

   The HPSH required for a centrifugal pump is given by the manufacturer as 3.0 m water abs. This pump is to be installed in a well with a pipe of 10 m length and 200 mm diameter with a flow velocity of 1.5 m/s. The atmospheric pressure is 9.7 m water abs and vapor pressure = 2.0 m water abs. Calculate the maximum suction height for the pump to run without cavitation. Take f = 0.02. **(12)**

Psychrometric chart at 1 atm total pressure.



L-2/T-2/EEE **Date: 31/03/2022**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-2/T-2 B. Sc. Engineering Examinations 2019-2020

Sub: **MATH 357** (Probability and Statistics)

Full Marks: 210 Time: 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION

The figures in the margin indicate full marks

SECTION – A

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

1. (a) The probability that a doctor correctly diagnoses a particular illness is 0.7. Given that the doctor makes an incorrect diagnosis, the probability that the patient files a lawsuit is 0.9. What is the probability that the doctor makes an incorrect diagnosis and the patient sues? **(10)**

(b) The proportion of the budget for a certain type of industrial company that is allotted to environmental and pollution control is coming under scrutiny. A data collection project determines that the distribution of these proportions is given by: **(12)**

$$f(y)=\begin{cases}5(1-y)^4, & 0\le y\le 1,\\ 0, & elsewhere.\end{cases}$$

i. Verify that the above is a valid density function.

ii. What is the probability that company chosen at random expends less than 10% of its budget on environmental and pollution controls?

iii. What is the probability that a company selected at random spends more than 50% of its budget on environmental and pollution controls?

(c) Two electronic components of a missile system work in harmony for the success of the total system. Let X and Y denote the life in hours of the two components. The joint density function of X and Y is: $f(x,y)=\begin{cases}ye^{-y(1+x)}, & x,y\ge 0,\\ 0, & elsewhere.\end{cases}$ **(13)**

i. Determine the marginal density functions for both random variables.

ii. What is the probability that the lives of both components will exceed 2 hours?

2. (a) Hospital administrators in large cities anguish about traffic in emergency rooms. At a particular hospital in a large city, the staff on hand cannot accommodate the patient traffic if there are more than 10 emergency cases in a given hour. It is assumed that patient arrival follows a Poisson process, and historical data suggest that, on the average, 5 emergencies arrive per hour. **(10)**

Contd P/2

MATH 357
Contd... Q. No. 2(a)

i. What is the probability that in a given hour the staff cannot accommodate the patient traffic?

ii. What is the probability that more than 20 emergencies arrive during a 3-hour shift?

(b) An oil drilling company ventures into various locations, and its success or failure is independent from one location to another. Suppose the probability of a success at any specific location is 0.25. **(12)**

i. What is the probability that the driller drills at 10 locations and has 1 success?

ii. The driller will go bankrupt if it drills 10 times before the first success occurs. What are the driller's prospects for bankruptcy?

(c) National security requires that defense technology be able to detect incoming projectiles or missiles. To make the defense system successful, multiple radar screens are required. Suppose that three independent screens are to be operated and the probability that any one screen will detect an incoming missile is 0.8. Obviously, if no screens detect an incoming projectile, the system is unworthy and must be improved. **(13)**

i. What is the probability that an incoming missile will not be detected by any of the three screens?

ii. What is the probability that the missile will be detected by only one screen?

iii. What is the probability that it will be detected by at least two out of three screens?

3. (a) Computer response time is an important application of exponential distribution. Suppose that a study of a certain computer system reveals that the response time, in seconds, has an exponential distribution with a mean of 3 seconds. **(10)**

i. What is the probability that response time exceeds 5 seconds?

ii. What is the probability that response time exceeds 10 seconds?

(b) The IQs of 1000 applicants to a certain college are approximately normally distributed with a mean of 115 and a standard deviation of 12. If the college requires an IQ of at least 95, how many of these students will be rejected on this basis of IQ, regardless of their other qualifications? Note that IQs are recorded to the nearest integers. **(12)**

(Necessary Table 1 and 2 are attached)

(c) In a biomedical research study, it was determined that the survival time, in weeks, of an animal subjected to a certain exposure of gamma radiation has a two-parameter gamma distribution with $\alpha = 5$ and $\beta = 10$. **(13)**

Contd P/3

MATH 357

Contd... Q. No. 3(c)

i. What is the mean survival time of a randomly selected animal of the type used in the experiment?

ii. What is the standard deviation of survival time?

iii. What is the probability that an animal survives more than 30 weeks?

4. (a) The length of time Y, in minutes, required to generate a human reflex to tear gas has the following density function: **(10)**

$$f(y)=\begin{cases}\frac{1}{4}e^{-\frac{y}{4}}, & 0\le y<\infty,\\ 0, & \textit{elsewhere.}\end{cases}$$

i. What is the mean time to reflex?

ii. Find $E(Y^2)$ and $Var(Y)$.

(b) The amount of time that a derive-through bank teller spends on a customer is a random variable with a mean of 3.2 minutes and a standard deviation of 1.6 minutes. If a random sample of 64 customers is observed, find the probability that their mean time at the teller's window is **(12)**

i. at most 2.7 minutes;

ii. more than 3.5 minutes;

iii. at least 3.2 minutes but less than 3.4 minutes.

(Necessary Table 1 and 2 are attached)

(c) The electric light bulbs of manufacturer A has a mean lifetime of 1400 hours (h) with a standard deviation of 200 h, while those of manufacturer B has a mean lifetime of 1200 h with a standard deviation of 100 h. If random samples of 125 bulbs of each brand are tested, what is the probability that the brand A bulbs will have a mean lifetime that is at least (i) 160 h and (ii) 250 h more than the brand B bulbs? **(13)**

(Necessary Table 1 and 2 attached)

SECTION – B

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

5. (a) The frequency distribution of class test marks of 50 students in a class are given below: **(17)**

Marks	10-15	15-20	20-25	25-30	30-35	35-40	40-45	45-50
No. of Students	1	2	9	8	12	9	8	1

Draw the ogive curve for the distribution and use it to determine the median marks and verify your result by using formula.

(b) The breaking strength of 80 test pieces of a certain alloy is given in the following table, the unit being given to the nearest pounds per square inch. **(18)**

Contd P/4

MATH 357

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

Breaking strength	44-46	46-48	48-50	50-52	52-54
No. of pieces	3	24	27	21	5

Calculate the average breaking strength of the alloy and the standard deviation. Also calculate the percentage of observations lying between mean $\pm 2\sigma$.

6. (a) What is rank correlation? When do you need it? Derive a formula to calculate the rank correlation coefficient? Calculate the rank correlation coefficient from the following data. **(20)**

Expenditure on advertisement	10	15	14	25	14	14	20	22
Profit	6	25	12	18	25	40	10	7

(b) The following table show distance to transmitter (X) and corresponding wireless signal strength (Y). **(15)**

Distance to transmitter (m)	13	1	17	19	14	15	15	8	13	3
Wireless signal strength (dB)	34.4	38.4	30.4	29.7	30.1	33.9	32.8	35.2	34.9	36.8

i) Find the regression line of Y on X.

ii) Predict what the signal strength would be if the distance was 10 meter.

7. (a) What do you mean by confidence interval? Scholastic Aptitude Test (SAT) mathematics scores of a random sample of 500 high school seniors in the state of Texas are collected, and the sample mean and standard deviation are found to be 501 and 112, respectively. Find a 99% confidence interval on the mean SAT mathematics score for seniors in the state of Texas. **(10)**

(b) A researcher speculates that because of differences in diet, Japanese children may have a lower mean blood cholesterol level than U.S. children do. Suppose that the mean level for U.S. children is known to be 170. Let μ represent the mean blood cholesterol level for all Japanese children. What hypotheses should the researcher test? **(5)**

(c) A manufacturer of sports equipment has developed a new synthetic fishing line that the company claims has a mean breaking strength of 8 kilograms with a standard deviation of 0.5 kilogram. Test the hypothesis that $\mu = 8$ kilograms against the alternative that $\mu \neq 8$ kilograms if a random sample of 50 lines is tested and found to have a mean breaking strength of 7.8 kilograms. Use a 0.01 level of significance. **(20)**

(Necessary Table 1 and 2 have been attached)

Contd P/5

MATH 357

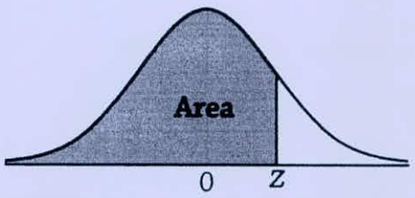
8. (a) Using moments calculate the coefficients of Skewness and Kurtosis from the following distribution and comment on the result obtained. **(18)**

Profits (In Taka)	70-90	90-110	110-130	130-150	150-170
No. of Companies	8	11	18	9	4

(b) The following table shows the yields per acre of four different plant crops grown on lots treated with three different types of fertilizer. Test at 5% level of significance whether there is a difference in yield per acre (i) due to the fertilizers and (ii) due to the crops. **(17)**

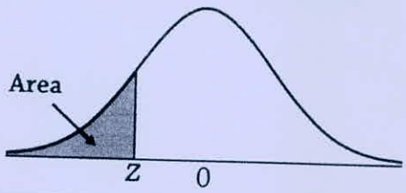
	Crop I	Crop II	Crop III	Crop IV
Fertilizer A	4.5	6.4	7.2	6.7
Fertilizer B	8.8	7.8	9.6	7.0
Fertilizer C	5.9	6.8	5.7	5.2

(Necessary Table 3 have been attached)



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	0.9452	0.9463	0.9474	0.9484	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	0.9893	0.9896	0.9898	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990
3.1	0.9990	0.9991	0.9991	0.9991	0.9992	0.9992	0.9992	0.9992	0.9993	0.9993
3.2	0.9993	0.9993	0.9994	0.9994	0.9994	0.9994	0.9994	0.9995	0.9995	0.9995
3.3	0.9995	0.9995	0.9995	0.9996	0.9996	0.9996	0.9996	0.9996	0.9996	0.9997
3.4	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9997	0.9998

Table No1:Necessary table for question no. 3(b), 4(b), 4(c) and 7(c)



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
-3.4	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002
-3.3	0.0005	0.0005	0.0005	0.0004	0.0004	0.0004	0.0004	0.0004	0.0004	0.0003
-3.2	0.0007	0.0007	0.0006	0.0006	0.0006	0.0006	0.0006	0.0005	0.0005	0.0005
-3.1	0.0010	0.0009	0.0009	0.0009	0.0008	0.0008	0.0008	0.0008	0.0007	0.0007
-3.0	0.0013	0.0013	0.0013	0.0012	0.0012	0.0011	0.0011	0.0011	0.0010	0.0010
-2.9	0.0019	0.0018	0.0018	0.0017	0.0016	0.0016	0.0015	0.0015	0.0014	0.0014
-2.8	0.0026	0.0025	0.0024	0.0023	0.0023	0.0022	0.0021	0.0021	0.0020	0.0019
-2.7	0.0035	0.0034	0.0033	0.0032	0.0031	0.0030	0.0029	0.0028	0.0027	0.0026
-2.6	0.0047	0.0045	0.0044	0.0043	0.0041	0.0040	0.0039	0.0038	0.0037	0.0036
-2.5	0.0062	0.0060	0.0059	0.0057	0.0055	0.0054	0.0052	0.0051	0.0049	0.0048
-2.4	0.0082	0.0080	0.0078	0.0075	0.0073	0.0071	0.0069	0.0068	0.0066	0.0064
-2.3	0.0107	0.0104	0.0102	0.0099	0.0096	0.0094	0.0091	0.0089	0.0087	0.0084
-2.2	0.0139	0.0136	0.0132	0.0129	0.0125	0.0122	0.0119	0.0116	0.0113	0.0110
-2.1	0.0179	0.0174	0.0170	0.0166	0.0162	0.0158	0.0154	0.0150	0.0146	0.0143
-2.0	0.0228	0.0222	0.0217	0.0212	0.0207	0.0202	0.0197	0.0192	0.0188	0.0183
-1.9	0.0287	0.0281	0.0274	0.0268	0.0262	0.0256	0.0250	0.0244	0.0239	0.0233
-1.8	0.0359	0.0351	0.0344	0.0336	0.0329	0.0322	0.0314	0.0307	0.0301	0.0294
-1.7	0.0446	0.0436	0.0427	0.0418	0.0409	0.0401	0.0392	0.0384	0.0375	0.0367
-1.6	0.0548	0.0537	0.0526	0.0516	0.0505	0.0495	0.0485	0.0475	0.0465	0.0455
-1.5	0.0668	0.0655	0.0643	0.0630	0.0618	0.0606	0.0594	0.0582	0.0571	0.0559
-1.4	0.0808	0.0793	0.0778	0.0764	0.0749	0.0735	0.0721	0.0708	0.0694	0.0681
-1.3	0.0968	0.0951	0.0934	0.0918	0.0901	0.0885	0.0869	0.0853	0.0838	0.0823
-1.2	0.1151	0.1131	0.1112	0.1093	0.1075	0.1056	0.1038	0.1020	0.1003	0.0985
-1.1	0.1357	0.1335	0.1314	0.1292	0.1271	0.1251	0.1230	0.1210	0.1190	0.1170
-1.0	0.1587	0.1562	0.1539	0.1515	0.1492	0.1469	0.1446	0.1423	0.1401	0.1379
-0.9	0.1841	0.1814	0.1788	0.1762	0.1736	0.1711	0.1685	0.1660	0.1635	0.1611
-0.8	0.2119	0.2090	0.2061	0.2033	0.2005	0.1977	0.1949	0.1922	0.1894	0.1867
-0.7	0.2420	0.2389	0.2358	0.2327	0.2296	0.2266	0.2236	0.2206	0.2177	0.2148
-0.6	0.2743	0.2709	0.2676	0.2643	0.2611	0.2578	0.2546	0.2514	0.2483	0.2451
-0.5	0.3085	0.3050	0.3015	0.2981	0.2946	0.2912	0.2877	0.2843	0.2810	0.2776
-0.4	0.3446	0.3409	0.3372	0.3336	0.3300	0.3264	0.3228	0.3192	0.3156	0.3121
-0.3	0.3821	0.3783	0.3745	0.3707	0.3669	0.3632	0.3594	0.3557	0.3520	0.3483
-0.2	0.4207	0.4168	0.4129	0.4090	0.4052	0.4013	0.3974	0.3936	0.3897	0.3859
-0.1	0.4602	0.4562	0.4522	0.4483	0.4443	0.4404	0.4364	0.4325	0.4286	0.4247
-0.0	0.5000	0.4960	0.4920	0.4880	0.4840	0.4801	0.4761	0.4721	0.4681	0.4641

Table No 2: Necessary table for question no. 3(b), 4(b), 4(c) 7(c)

95th Percentile Values
for the *F* Distribution
(ν_1 degrees of freedom in numerator)
(ν_2 degrees of freedom in denominator)

ν_2 \ ν_1	1	2	3	4	5	6	7	8	9	10	12	15	20	24	30	40	60	120	∞
1	161	200	216	225	230	234	237	239	241	242	244	246	248	249	250	251	252	253	254
2	18.5	19.0	19.2	19.2	19.3	19.3	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.5	19.5	19.5	19.5	19.5	19.5
3	10.1	9.55	9.28	9.12	9.01	8.94	8.89	8.85	8.81	8.79	8.74	8.70	8.66	8.64	8.62	8.59	8.57	8.55	8.53
4	7.71	6.94	6.59	6.39	6.26	6.16	6.09	6.04	6.00	5.96	5.91	5.86	5.80	5.77	5.75	5.72	5.69	5.66	5.63
5	6.61	5.79	5.41	5.19	5.05	4.95	4.88	4.82	4.77	4.74	4.68	4.62	4.56	4.53	4.50	4.46	4.43	4.40	4.37
6	5.99	5.14	4.76	4.53	4.39	4.28	4.21	4.15	4.10	4.06	4.00	3.94	3.87	3.84	3.81	3.77	3.74	3.70	3.67
7	5.59	4.74	4.35	4.12	3.97	3.87	3.79	3.73	3.68	3.64	3.57	3.51	3.44	3.41	3.38	3.34	3.30	3.27	3.23
8	5.32	4.46	4.07	3.84	3.69	3.58	3.50	3.44	3.39	3.35	3.28	3.22	3.15	3.12	3.08	3.04	3.01	2.97	2.93
9	5.12	4.26	3.86	3.63	3.48	3.37	3.29	3.23	3.18	3.14	3.07	3.01	2.94	2.90	2.86	2.83	2.79	2.75	2.71
10	4.96	4.10	3.71	3.48	3.33	3.22	3.14	3.07	3.02	2.98	2.91	2.85	2.77	2.74	2.70	2.66	2.62	2.58	2.54
11	4.84	3.98	3.59	3.36	3.20	3.09	3.01	2.95	2.90	2.85	2.79	2.72	2.65	2.61	2.57	2.53	2.49	2.45	2.40
12	4.75	3.89	3.49	3.26	3.11	3.00	2.91	2.85	2.80	2.75	2.69	2.62	2.54	2.51	2.47	2.43	2.38	2.34	2.30
13	4.67	3.81	3.41	3.18	3.03	2.92	2.83	2.77	2.71	2.67	2.60	2.53	2.46	2.42	2.38	2.34	2.30	2.25	2.21
14	4.60	3.74	3.34	3.11	2.96	2.85	2.76	2.70	2.65	2.60	2.53	2.46	2.39	2.35	2.31	2.27	2.22	2.18	2.13
15	4.54	3.68	3.29	3.06	2.90	2.79	2.71	2.64	2.59	2.54	2.48	2.40	2.33	2.29	2.25	2.20	2.16	2.11	2.07
16	4.49	3.63	3.24	3.01	2.85	2.74	2.66	2.59	2.54	2.49	2.42	2.35	2.28	2.24	2.19	2.15	2.11	2.06	2.01
17	4.45	3.59	3.20	2.96	2.81	2.70	2.61	2.55	2.49	2.45	2.38	2.31	2.23	2.19	2.15	2.10	2.06	2.01	1.96
18	4.41	3.55	3.16	2.93	2.77	2.66	2.58	2.51	2.46	2.41	2.34	2.27	2.19	2.15	2.11	2.06	2.02	1.97	1.92
19	4.38	3.52	3.13	2.90	2.74	2.63	2.54	2.48	2.42	2.38	2.31	2.23	2.16	2.11	2.07	2.03	1.98	1.93	1.88
20	4.35	3.49	3.10	2.87	2.71	2.60	2.51	2.45	2.39	2.35	2.28	2.20	2.12	2.08	2.04	1.99	1.95	1.90	1.84
21	4.32	3.47	3.07	2.84	2.68	2.57	2.49	2.42	2.37	2.32	2.25	2.18	2.10	2.05	2.01	1.96	1.92	1.87	1.81
22	4.30	3.44	3.05	2.82	2.66	2.55	2.46	2.40	2.34	2.30	2.23	2.15	2.07	2.03	1.98	1.94	1.89	1.84	1.78
23	4.28	3.42	3.03	2.80	2.64	2.53	2.44	2.37	2.32	2.27	2.20	2.13	2.05	2.01	1.96	1.91	1.86	1.81	1.76
24	4.26	3.40	3.01	2.78	2.62	2.51	2.42	2.36	2.30	2.25	2.18	2.11	2.03	1.98	1.94	1.89	1.84	1.79	1.73
25	4.24	3.39	2.99	2.76	2.60	2.49	2.40	2.34	2.28	2.24	2.16	2.09	2.01	1.96	1.92	1.87	1.82	1.77	1.71
26	4.23	3.37	2.98	2.74	2.59	2.47	2.39	2.32	2.27	2.22	2.15	2.07	1.99	1.95	1.90	1.85	1.80	1.75	1.69
27	4.21	3.35	2.96	2.73	2.57	2.46	2.37	2.31	2.25	2.20	2.13	2.06	1.97	1.93	1.88	1.84	1.79	1.73	1.67
28	4.20	3.34	2.95	2.71	2.56	2.45	2.36	2.29	2.24	2.19	2.12	2.04	1.96	1.91	1.87	1.82	1.77	1.71	1.65
29	4.18	3.33	2.93	2.70	2.55	2.43	2.35	2.28	2.22	2.18	2.10	2.03	1.94	1.90	1.85	1.81	1.75	1.70	1.64
30	4.17	3.32	2.92	2.69	2.53	2.42	2.33	2.27	2.21	2.16	2.09	2.01	1.93	1.89	1.84	1.79	1.74	1.68	1.62
40	4.08	3.23	2.84	2.61	2.45	2.34	2.25	2.18	2.12	2.08	2.00	1.92	1.84	1.79	1.74	1.69	1.64	1.58	1.51
60	4.00	3.15	2.76	2.53	2.37	2.25	2.17	2.10	2.04	1.99	1.92	1.84	1.75	1.70	1.65	1.59	1.53	1.47	1.39
120	3.92	3.07	2.68	2.45	2.29	2.18	2.09	2.02	1.96	1.91	1.83	1.75	1.66	1.61	1.55	1.50	1.43	1.35	1.25
∞	3.84	3.00	2.60	2.37	2.21	2.10	2.01	1.94	1.88	1.83	1.75	1.67	1.57	1.52	1.46	1.39	1.32	1.22	1.00

Table 3: Necessary table for question no. 8(b)