

9. (a) What are JSP implicit objects? Describe.  
(b) How are JSP requests handled? What are the advantages of JSP? Describe.

5+5

## B.Tech. (CS / IT) (V Sem.)

723

CS 304

## B.Tech. (CS / IT) (FIFTH SEMESTER) EXAMINATION, DECEMBER 2022

PAPER CS 304—Java Programming

TIME ALLOWED : THREE HOURS

Maximum Marks—60

*Attempt six questions in all, selecting two questions from each Section. All questions carry equal marks.*

### SECTION A

1. (a) Explain main() method in java. What is java's magic byte code? Explain in detail.  
(b) Answer the following:-
  - (i) With the base of Unicode, Java platform has become better. Explain how.
  - (ii) Describe all the primitive data types supported by Java with appropriate examples. Also specify their storage capacity/range.5+5
2. (a) What do you understand by type casting and automatic promotion? Explain with suitable examples.

(b) What are the different components of JDK? Explain.  
Also describe the concept of JRE.

(c) Illustrate the difference between Java and C++. Why  
is Java language important in relevance to the Internet?  
4+3+3

3. (a) What is constructor chaining and why do we need it?  
Give an example.

(b) The following program has several errors. Modify it so  
that it will compile and run without errors :

```
java PUBLIC CLASS temperature {  
    PUBLIC void main(string args) {  
        double fahrenheit = 62.5;  
        /* Convert */  
        double celsius = f2c (fahrenheit);  
        System.out.println(fahrenheit + 'F=' + celsius + 'C');  
    }  
    double f2c(float fahr) {  
        RETURN (fahr - 32) * 5/9;  
    }  
}
```

(c) Explain various purposes of this and super keyword  
with suitable examples.  
4+3+3

#### SECTION B

4. (a) What is mean by multi-threading? What are the 2 ways  
of creating a thread? Which is the best way and why?  
(b) What is use of synchronized keyword and serialization?  
Describe with suitable example.  
5+5

5. You need to store elements in a collection that guarantees  
that no duplicates are stored and all elements can be  
accessed in natural order. Which interface among the  
following provides this capability? Also give two examples  
for the selected interface.

- (a) Java.util.Map.
- (b) Java.util.Set.
- (c) Java.util.List.
- (d) Java.util.StoredSet.
- (e) Java.util.StoredMap.
- (f) Java.util.Collection.

6. (a) What is the purpose of JDBC drivers? How many times  
of driver use for database connectivity? Explain.  
(b) How many types of statement available in jdbc to  
execute sql commands? Differentiate and explain all with  
suitable examples.  
5+5

#### SECTION C

7. (a) What is a servlet? Explain the life cycle of servlet.  
(b) What is the difference between doGet() and doPost() ?  
(c) Differentiate between servlet and applet.  
4+3+3

8. (a) What do you know about Adapter classes? How do  
these classes differ from anonymous class? Explain with  
example.  
(b) Write a GUI application for print x and y coordinate  
on mouse movement.  
5+5

statement with relevant examples. Is there one best style of leadership? Comment on the statement with reasons.

## B.Tech. (CS/EE/IT) (V Sem.)

722

MGMT 310

### B.Tech. (CS/EE/IT) (FIFTH SEMESTER) EXAMINATION, DECEMBER 2022

#### MANAGEMENT

PAPER MGMT 310—Principles of Management

TIME ALLOWED : THREE HOURS

Maximum Marks—6

*The paper contains three questions from every Section aggregating nine questions. Students are required to attempt total of six questions, taking two questions from each Section.  
All questions carry equal marks.*

#### SECTION A

1. Explain the meaning and also adverse effects of the violation of the following principles of Fayol with the help of *one example* of each:—
  - (i) Division of Work
  - (ii) Unity of Command
  - (iii) Remuneration
  - (iv) Order.

2. What would you do in a situation where you are the supreme authority to make a strategically important decision for your organisation. You may take no one's advice in the end but at least get their input. A new angle on the problem may be surprisingly helpful in solidifying the decision or at least the way to go about making the decision work for you. Will you take the help of the others or would rather make the decision on your own?
3. Planning eliminates changes/uncertainties. Do you agree? Give reasons with instances in support of your answer. Can you recall a time when important plans were changed? What did you do?

#### SECTION B

4. "A manager alone cannot perform the entire task assigned to him; in order to meet the target, he should delegate authority." Comment on the statement with examples. Also state the problems in delegation of authority.
5. What is departmentation? Describe the various bases of departmentation. What scheme of departmentation will you suggest for a large marketing organization operating all over the country and why?
6. Motivation of personnel has become a very complicated task in the present-day scenario. Why? Compare and

contrast Maslow's hierarchy of needs theory with Herzberg's two factor theory.

#### SECTION C

7. "Communication is an indispensable activity in all organisations." Analyse this statement with suitable examples and thus bring out the significance of communication in an organisation.
8. A company XYZ Ltd. is manufacturing mobile phones both for domestic Indian market as well as for export. It has enjoyed a substantial market share and also had a loyal customer following. But lately it has been experiencing problems because its targets have not been met with regard to sales and customer satisfaction. Also, mobile market in India has grown tremendously and new players have come with better technology and pricing. This is causing problems for the company. It is planning to revamp its controlling system and take other steps necessary to rectify the problems it is facing.
  - (a) How can the company relate its planning with control in this line of business to ensure that its plans are actually implemented and targets attained?
  - (b) Give the steps in the control process that the company should follow to remove the problems it is facing.
9. "A good leader is one who understands his subordinates, their needs and their sources of satisfaction." Explain the

coefficient of voltage and current and also transmission coefficient of voltage and current for the load impedance not equal to surge impedance.

5

### SECTION C

7. (a) What is grading of cables? Explain in details with neat sketch. 5  
(b) The capacitances of a 3-phase cable are  $12.6 \mu\text{F}$  between the three bunched together and lead sheath; and also  $7.4 \mu\text{F}$  between one core and other two connected sheath. Find the charging current drawn by the cable when connected to  $66 \text{ kV}, 50 \text{ Hz}$  supply. 5
8. (a) Describe the loss tangent of power cable. The insulation resistance of a single core cable is  $495 \text{ M}\Omega$  per km. If the core diameter is  $2.5 \text{ cm}$  and resistivity of insulation is  $4.5 \times 10^{14} \Omega \text{ cm}$ , find the insulation thickness. 5  
(b) Explain the different types of distribution system. Also draw the diagram of each system. 5
9. (a) Describe the shunt capacitor compensation used for the voltage control. A load of  $15 \text{ kW}$  is having a power factor of  $0.85$  lagging; what could be the reactive power supplied to change the power factor to  $0.85$  leading. 5  
(b) Explain the methods of area control. Two generators  $G_1$  and  $G_2$  are having drooping characteristics of  $4\%$  and  $5\%$  respectively and capacities of  $400 \text{ MW}$ .  
(i) What is the sharing of each generator for a demand of  $600 \text{ MW}$ ?  
(ii) What is the maximum load that can be supplied without overloading of any generator? 5

## B.Tech. (EE) (V Sem.)

734

EEE 309

### B.Tech. (EE) (FIFTH SEMESTER) EXAMINATION, DECEMBER 2022

PAPER EEE 309— Power System – I

TIME ALLOWED : THREE HOURS

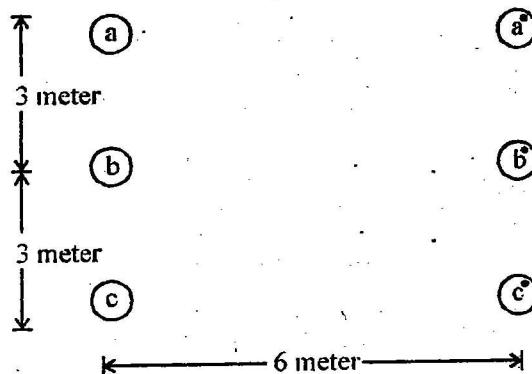
Maximum Marks— 60

*The question paper is divided into three Sections. Attempt six questions in all, selecting two questions from each Section. All questions carry equal marks.*

### SECTION A

1. (a) Discuss about the single line diagram of power system. A generating station has a connected load of  $43 \text{ MW}$  and a maximum demand of  $20 \text{ MW}$ , the units generated being  $61.5 \times 10^6$  per annum. Calculate :  
(i) the demand factor  
(ii) load factor. 5  
(b) Explain the functioning of thermal power plant in details. Draw the neat sketch of the plant. 5
2. (a) Spacing of the double circuit 3-phase overhead line is shown in figure below.

Turn over



The phase sequence is ABC and the line is completely transposed. The conductor radius is 1.3 cm. Find the inductance per phase per kilometer. 5

- (b) A short 3-phase transmission line with an impedance of  $6 + j8 \Omega$  per phase has sending and receiving end voltages of 120 kV and 118 kV respectively for receiving end load at p.f. of 0.9 lagging. Determine :
- power output
  - sending end power factor. 5
3. (a) Draw the phasor diagram for nominal  $\pi$  (pie) network of medium transmission line. A 3-phase, 50 Hz transmission line 100 km long delivers 20 MW at 0.9 power factor lagging and at 110 kV. The resistance and reactance of the line per phase per km are  $0.2 \Omega$  and  $0.4 \Omega$  respectively; while capacitance is  $2.5 \times 10^{-6}$  siemens/km/phase. Calculate :
- voltage at sending end
  - transmission efficiency.
- (Use nominal T method.) 5

- (b) Each line of a 3-phase system is suspended by a string of 3 identical insulators of self-capacitance  $C$  farad. The shunt capacitance of connecting metal work of each insulator is  $0.2 C$  to earth and  $0.1 C$  to line. Calculate the string efficiency of system if a guard ring increases the capacitance to the line of metal work of lowest insulator to  $0.3 C$ . 5

#### SECTION B

4. (a) Describe the impact of wind and ice loading on the transmission line. Also explain the sag template. Draw the required diagram also. 5
- (b) A 3-phase, 220 kV, 50 Hz transmission line consists of 1.5 cm radius conductor spread 2 meters apart in equilateral triangular configuration. If the temperature is 40°C and atmospheric pressure is 76 cm of Hz, calculate the corona loss per km of line. (Take  $m = 0.85$ ) 5
5. (a) Explain the critical disruptive and critical visual voltage. Comment on the factors influencing corona. 5
- (b) What are the different types of vibrations present in the transmission line? Describe the method to mitigate it. 5
6. (a) A transmission line has surge impedance of  $350 \Omega$  and it is terminated by a cable of surge impedance  $40 \Omega$ . What will be transmitted and reflected voltage at the junction, when a 200 kV surge is travelling through the line? Explain the practical applications of this question. 5
- (b) What are the propagation constant, surge impedance, surge impedance loading and loss free line? Obtain the reflection

**B.Tech. (EIE / MCTR) (V Sem.)**

736

**EIE 308**

**B.Tech. (FIFTH SEMESTER)  
EXAMINATION, DECEMBER 2022**

(EIE / MCTR)

**PAPER EIE 308—Industrial Instrumentation**

**TIME ALLOWED : THREE HOURS**

**Maximum Marks—60**

*Attempt six questions in all, selecting two questions from each Section. All questions carry equal marks.*

**SECTION A**

1. (a) Explain the working of photo-emissive cell. Write any two applications of photoelectric cells. 5  
(b) What are the different elastic transducers used for the pressure measurement? Illustrate the working principle of any one in details. 5
  
2. (a) Suggest an instrument that uses Piezoelectric transducer. Discuss its basic principle, construction and working. Also write properties of materials used for Piezoelectric transducers. 5

- (b) Discuss the working principle of the Pirani gauge. 5
3. (a) What is meant by noise in instrumentation? Explain electrical noise and magnetic noise. 5
- (b) A strain gauge has a gauge factor of 4. If the strain gauge is attached to a metal bar that stretches from 0.25 m to 0.258 m when strained what is the percentage of change in resistance? If the unstrained value of the gauge is 120 ohm, what is the resistance value of the gauge after it is strained? 5
8. (a) Which transducer is used for measuring vibration? Explain three important parameters used to measure vibration. 5
- (b) What is the principle of measurement of pH-by-pH sensor? 5
9. (a) What is the relation between thermal conductivity and thickness? 5
- (b) What is virtual instrumentation system? Discuss three main components of a virtual instrument? 5

#### SECTION B

4. (a) What are the advantages and disadvantages of mercury in glass thermometer? 5
- (b) Discuss working principle of bimetallic strip. 5
5. (a) What are the different types of level measurement? 5
- (b) How does venturimeter measure flow? 5
6. (a) What is the Ultrasonic Flow Meter working principle? 5
- (b) Suggest an instrument that uses capacitive type level sensor. Discuss its basic principle, construction and working. 5

#### SECTION C

7. (a) What is the difference between AC and DC tachometer? 5
- (b) Illustrate the principle of DC tachogenerator. 5

- statement that "Single phase induction motors are not self-starting". 5
- (b) Draw the speed-torque and phasor diagram of capacitor start capacitor run motor with its advantages. 5
8. (a) A 250 V DC supply is applied to a single phase AC motor. Motor takes a current of 1.1 A with 3000 r.p.m. speed. What will be the power factor and speed when it is connected across 250 V, 50 Hz AC supply? The inductance and resistance of the motor are 0.22 H and 42 Ω respectively. 5
- (b) Describe the constructional features of universal motor with their advantages and applications. Also comment on the working principle of universal motor. 5
9. (a) Describe the constructional features, advantages, disadvantages and applications of variable reluctance stepper motors. What is the stepping rate of pulses? 5
- (b) The inductance and resistance of a series universal motor are 0.15 H and 48 Ω. When a 280 V DC supply is connected across it, 1.5 A current with 2000 r.p.m. is flowing, find out the value of back e.m.f. when there is : (i) AC supply and (ii) DC supply. 5

## B.Tech. (MCTR) (V Sem.)

737

EEE 307

## B.Tech. (MCTR) (FIFTH SEMESTER) EXAMINATION, DECEMBER 2022

PAPER EEE 307— Electrical Machines – II

TIME ALLOWED : THREE HOURS

Maximum Marks— 60

*Attempt six questions in all, selecting two questions from each Section. All questions carry equal marks.*

### SECTION A

1. (a) A 3300 V, star connected synchronous motor is operating at constant terminal voltage and constant excitation. Its synchronous impedance is  $0.8 + j5 \Omega$ . It operates at a power factor of 0.8 leading when drawing 800 kW from the mains. Find its power factor when the input is increased to 1200 kW, excitation remaining constant. 5
- (b) A synchronous generator is supplying zero power factor (i) lagging and (ii) leading current. Show that the terminal voltage  $V_t$  and excitation emf  $E_f$  are in phase. 5
2. (a) Show that in a generating synchronous machine the phase relationship (lag/lead) between  $V_t$  and  $E_f$  is independent

- of the power factor (lag/lead). Draw the phasor diagrams to discover your answer. 5
- (b) A 200 kVA, 3.3 kV, 50 Hz, three phase synchronous generator is star connected. The effective armature resistance is  $5 \Omega/\text{phase}$  and synchronous reactance is  $29.2 \Omega/\text{phase}$ . At full load calculate the voltage regulation for the following power factors : 5
- 0.707 leading
  - Unity
  - 0.707 lagging.
3. (a) The synchronous reactance of an alternator is not constant over the entire operating range. Why is this so? What value would you use? 5
- (b) A 440 V, 50 Hz, 4-pole 3-phase, delta connected motor has a leakage impedance of  $(0.3 + j5.5 + 0.25/S) \Omega/\text{phase}$  (delta phase) referred to the stator. The stator to rotor voltage ratio is 2.5. Determine the external resistance to be inserted in each star phase of the rotor winding such that the motor develops a gross torque of 150 N-m at a speed of 1250 rpm where,  $S$  = Slip of motor. 5

#### SECTION B

4. (a) A 3-phase, induction motor has a starting torque of 150% and a maximum torque of 250% of the full load torque. Neglect stator resistance and assume constant rotor resistance. Compute :
- The slip at maximum torque
  - Full-load slip and

(iii) The rotor current at starting in terms of full-load rotor current. 5

- (b) Discuss the production of starting torque, through the concept of interaction of flux and mmf waves in a 3-phase slip-ring induction motor. 5

5. (a) A 3-phase, delta connected, 4-pole 50 Hz induction motor has a stator resistance of  $0.4 \Omega$  per phase at the operating temperature. For a line current of 20 A the total stator input is 4000 watts. For negligible stator core losses, find out the internal torque. 5
- (b) Describe the principle of operation of a 3-phase induction motor. Explain why the rotor is forced to rotate in the direction of rotating magnetic field. 5

6. (a) The rotor of a 3-phase induction motor has  $0.04 \Omega$  resistance per phase and  $0.2 \Omega$  standstill reactance per phase. What external resistance is required in the rotor circuit in order to get half of the maximum torque at starting? Neglect stator impedance. By what percentage will this external resistance change the current and power factor at starting? 5

- (b) Explain the production of torque in a 3-phase slip-ring induction motor when the rotor is running with a slip  $s$ . Hence introduce the concept of load angle. 5

#### SECTION C

7. (a) In case of single phase induction motor, explain "BACKWARD" and "FORWARD" fields. Comment on the

pathway flux in lysine biosynthesis by transient or steady state intensity measurements. 10

### SECTION C

7. (a) The regulatory systems of prokaryotes and eukaryotes are quite distinct, a reflection of their distinct "lifestyles"—Explain. 5
- (b) Cross-regulation may be especially important in the control of pathways of central carbon metabolism. How? 5
8. Describe following systematic methods for analysis of structure of metabolic networks :  
(a) Group flux control coefficient.  
(b) Control of flux distribution at branch point. 5+5
9. (a) What are the energetic costs of key cellular processes? 5  
(b) Distinguish between:-  
(i) Endothermic and exothermic reactions  
(ii) Change in internal energy and change in enthalpy. 5

### B.Tech. (V Sem.)

739

BT 309

### B.Tech. (FIFTH SEMESTER) EXAMINATION, DECEMBER 2022

### BIOTECHNOLOGY

PAPER BT 309— Metabolic Engineering

TIME ALLOWED : THREE HOURS

Maximum Marks—60

*Attempt six questions in all, selecting two questions from each Section. All questions carry equal marks.*

### SECTION A

1. (a) How are assembly reactions, polymerization reactions and fueling reactions significant to overall process of macromolecules and correlate a first-order reaction rate with relaxation time? 5
- (b) In group translocation, the transport process is coupled with a subsequent conversion of the transported compound. Explain this by a well-established example. 5
2. (a) Metabolic engineering is a field of broad fundamental and practical importance. How? 5

- (b) In many biological systems, it has been observed that the facilitated transport rate of compounds follows Michaelis-Menten saturation type kinetics. Derive a rate expression following facilitated diffusion mechanism. 5

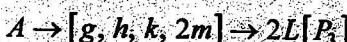
3. Feedback inhibition and activation are extremely rapid responses for regulating enzyme activity in all types of cells. How is allosteric enzyme cooperativity fundamentally different class of regulatory enzymes? Derive a generalized equation for  $n$  cooperative active sites that explains its mechanism. 10

### SECTION B

4. All possible biosynthetic routes leading from metabolite  $A$  to metabolite  $L$  is an enzymatic database comprising the following reactions :

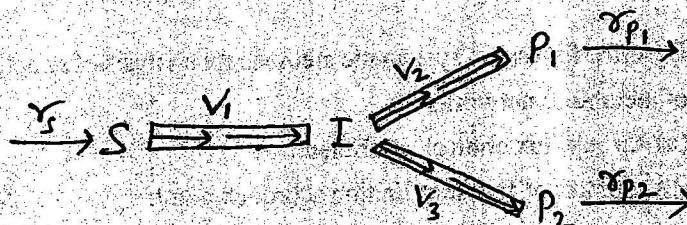
- (a)  $A \rightarrow B$
- (b)  $B \leftrightarrow C$
- (c)  $C \leftrightarrow D$
- (d)  $C + D \leftrightarrow F + K$
- (e)  $F + K \leftrightarrow H + E$
- (f)  $H + D \leftrightarrow E + F$
- (g)  $A \leftrightarrow E$
- (h)  $E \leftrightarrow F + G$
- (k)  $F \leftrightarrow G$
- (m)  $G \leftrightarrow L$

- (a) How will you process  $G$ ,  $H$  and  $K$  from the enzymatic database?
- (b) Three pathways are all feasible solutions to the original synthesis problem.



Conclude your observation about the three pathways constructed. 5+5

5. A simplified pathway diagram suitable for metabolic flux analysis as follows :



- (a) Perform a flux balance on the simplified metabolic network when stoichiometry is ( $S \rightarrow 0.5I$ ,  $I \rightarrow 2P_1$  and  $I \rightarrow P_2$ ), rates of  $P_1$  and  $P_2$  are given as ( $r_{P_1} = 0.05 \text{ mol g}^{-1}\text{h}^{-1}$  and  $r_{P_2} = 0.08 \text{ mol g}^{-1}\text{h}^{-1}$ ) and  $S_c^{-1}$  is given as follows :

$$S_c^{-1} = \begin{bmatrix} 1 & 2 & 1 & 2 \\ 0 & 2 & 1 & 2 \\ 0 & 0 & 0.5 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix}$$

- (b) Calculate the flux split ratio between the two products  $P_1$  and  $P_2$  at branch point I. 5

6. What is direct flux determination from fractional label enrichment by isotope labelling. Explain the determination of bypass

**B.Tech. (Fifth Semester) EXAMINATION, DECEMBER 2022**

**PAPER CHE 320—Mechanical Operations**

**TIME ALLOWED : THREE HOURS**

**Maximum Marks—60**

**CHEMICAL ENGINEERING**

The question paper is divided into three Sections. Attempt six questions in all, selecting two questions from each Section. All questions carry equal marks.

In case of missing data or incorrect information make appropriate assumption(s) and mention them clearly in answer sheet.

Graph paper will be provided in the examination, if needed. Calculators are allowed in the examination.

The screen analysis shown for a sample of feed is as follows:

**Section A**

Mesh	Screen opening $D_m$ , mm	Mass retained, g
4	4.75	0.0000
5	3.35	33.5
6	2.80	324
8	2.00	315.5
10	1.70	120
14	1.18	78
18	0.85	79
25	0.60	39
30	0.30	26
36	0.25	27
52	0.18	28
85	0.125	40
100	0.115	26
120	0.106	27
130	0.075	28
200	0.016	29
400	0.001	69

0.5. For the material between 4-mesh and 200-mesh in particle size, calculate (a) specific surface area,  $A_s$ , in  $\text{mm}^2/\text{g}$ ; (b) volume mean diameter,  $D_V$ ; (c) mass mean diameter,  $D_w$ ; (d) Sauter mean diameter,  $D_s$ , and (e) total population in one unit of sample,  $N_W$ .

- Q.2 (a) Discuss the empirical laws for size reduction.
- Q.3 (a) Explain in detail the principle, construction and working of a ball mill with a neat diagram.
- (b) 270 kW of power is required to crush 150 tonnes/h of a material. If 80% of the feed passes through a 30 mm screen and 80% of the product passes through a 3 mm screen, calculate the work index of the material and what will be the power required for the same feed at 150 tonnes/h to be crushed to a product such that 80% is to pass through a 1.5 mm screen?
- (ii) Determine the consumption of energy to crush the same feed to an average product size of 1.5 mm using Rittinger's law.
- Q.4 A leaf filter with  $1 \text{ m}^2$  of filtering surface is operated at a constant pressure of 1.8 bar (gauge) gave the following results:
- | Filtrate volume ( $\text{m}^3$ ) | 3.99 | 6.09 | 7.65 | 9.63 | 11.33 | Time (min) |
|----------------------------------|------|------|------|------|-------|------------|
| 10                               | 20   | 30   | 45   | 60   |       |            |
- The original slurry contained 10% by weight of solid calcium carbonate (specific gravity = 2.72) in water and the cake formed is essentially incompressible.
- (i) Determine the time required to wash the cake formed at the end of 70 minutes for filtering at the same pressure using 3.0  $\text{m}^3$  of wash water.
- Q.5 (a) Mentioning all the assumptions derive an equation for the terminal settling of a particle settling through a fluid. Explain different regions formed in terms of the drag coefficient and Reynolds number for spherical particle in terms of the drag coefficient of fluid = 997  $\text{kg/m}^3$ . What is the dia (in mm, rounded off to the second decimal place) of the largest sphere that settles in the Stoke's law regime?
- (b) Consider a rigid solid sphere falling with a constant velocity in a fluid. The following data are known at the conditions of interest: viscosity of the fluid = 0.1 Pa.s, acceleration due to gravity = 10 m/s<sup>2</sup>, density of the particle = 1164  $\text{kg/m}^3$  and density of fluid = 997  $\text{kg/m}^3$ . In the Stoke's law regime?
- Q.6 (a) With the help of a neat diagram explain the following:
- (i) Tabling; (ii) Cone classifier; and (iii) floatation.
- (b) Consider a rigid solid sphere falling with a constant velocity in a fluid. The following drag force and terminal settling velocity.
- (c) If the time for dumping the cake are reassembled the pressure is 60 minutes, what is the optimum cycle time and what is the volume of filtrate collected per cycle?
- (d) Assume wash water is used in the same proportion to final filtrate as in part (i).
- Q.7 (a) Calculate the critical speed in revolutions per minute recommended for a ball mill that is 1200 mm in diameter charged with 75 mm balls. It, (i) Operating speed of ball mill is 42% of the critical speed, and (ii) Critical speed is 35% more than operating speed of ball mill.
- (b) What rotational speed in revolutions per minute would you recommend for a ball mill that is 1200 mm in diameter charged with 75 mm balls?
- (c) Explain in detail the principle, construction and working of a ball mill with a neat diagram. Also, derive an expression for critical speed of a ball mill.
- Q.8 (a) A leaf filter with  $1 \text{ m}^2$  of filtering surface is operated at a constant pressure of 1.8 bar (gauge) gave the following results:
- | Filtrate volume ( $\text{m}^3$ ) | 3.99 | 6.09 | 7.65 | 9.63 | 11.33 | Time (min) |
|----------------------------------|------|------|------|------|-------|------------|
| 10                               | 20   | 30   | 45   | 60   |       |            |
- The original slurry contained 10% by weight of solid calcium carbonate (specific gravity = 2.72) in water and the cake formed is essentially incompressible.
- (i) Determine the time required to wash the cake formed at the end of 70 minutes for filtering at the same pressure using 3.0  $\text{m}^3$  of wash water.
- Q.9 (a) Mentioning all the assumptions derive an equation for the terminal settling of a particle settling through a fluid. Explain different regions formed in terms of the drag coefficient and Reynolds number for spherical particle in terms of the drag coefficient of fluid = 997  $\text{kg/m}^3$ . What is the dia (in mm, rounded off to the second decimal place) of the largest sphere that settles in the Stoke's law regime?
- (b) Consider a rigid solid sphere falling with a constant velocity in a fluid. The following data are known at the conditions of interest: viscosity of the fluid = 0.1 Pa.s, acceleration due to gravity = 10 m/s<sup>2</sup>, density of the particle = 1164  $\text{kg/m}^3$  and density of fluid = 997  $\text{kg/m}^3$ . In the Stoke's law regime?
- Q.10 (a) If the time for dumping the cake are reassembled the pressure is 60 minutes, what is the optimum cycle time and what is the volume of filtrate collected per cycle?
- (b) Assume wash water is used in the same proportion to final filtrate as in part (i).
- Q.11 (a) Determine the time required to wash the cake formed at the end of 70 minutes for filtering at the same pressure using 3.0  $\text{m}^3$  of wash water.
- (b) If the time for dumping the cake are reassembled the pressure is 60 minutes, what is the optimum cycle time and what is the volume of filtrate collected per cycle?
- Q.12 (a) With the help of a neat diagram explain the following:
- (i) Tabling; (ii) Cone classifier; and (iii) floatation.
- (b) Consider a rigid solid sphere falling with a constant velocity in a fluid. The following data are known at the conditions of interest: viscosity of the fluid = 0.1 Pa.s, acceleration due to gravity = 10 m/s<sup>2</sup>, density of the particle = 1164  $\text{kg/m}^3$  and density of fluid = 997  $\text{kg/m}^3$ . In the Stoke's law regime?
- Q.13 (a) Explain in detail the principle, construction and working of a ball mill with a neat diagram. Also, derive an expression for critical speed of a ball mill.
- (b) What rotational speed in revolutions per minute would you recommend for a ball mill that is 1200 mm in diameter charged with 75 mm balls?
- (c) Calculate the critical speed in revolutions per minute of a ball mill that is 1200 mm in diameter charged with 75 mm balls. It, (i) Operating speed of ball mill is 42% of the critical speed, and (ii) Critical speed is 35% more than operating speed of ball mill.
- Q.14 (a) Calculate the critical speed in revolutions per minute of a ball mill that is 1200 mm in diameter charged with 75 mm balls. It, (i) Operating speed of ball mill is 42% of the critical speed, and (ii) Critical speed is 35% more than operating speed of ball mill.
- (b) What rotational speed in revolutions per minute would you recommend for a ball mill that is 1200 mm in diameter charged with 75 mm balls?
- (c) Calculate the critical speed in revolutions per minute of a ball mill that is 1200 mm in diameter charged with 75 mm balls. It, (i) Operating speed of ball mill is 42% of the critical speed, and (ii) Critical speed is 35% more than operating speed of ball mill.
- Q.15 (a) Mentioning all the assumptions derive an equation for the terminal settling of a particle settling through a fluid. Explain different regions formed in terms of the drag coefficient and Reynolds number for spherical particle in terms of the drag coefficient of fluid = 997  $\text{kg/m}^3$ . What is the dia (in mm, rounded off to the second decimal place) of the largest sphere that settles in the Stoke's law regime?
- (b) Consider a rigid solid sphere falling with a constant velocity in a fluid. The following data are known at the conditions of interest: viscosity of the fluid = 0.1 Pa.s, acceleration due to gravity = 10 m/s<sup>2</sup>, density of the particle = 1164  $\text{kg/m}^3$  and density of fluid = 997  $\text{kg/m}^3$ . In the Stoke's law regime?
- Q.16 (a) With the help of a neat diagram explain the following:
- (i) Tabling; (ii) Cone classifier; and (iii) floatation.
- (b) Consider a rigid solid sphere falling with a constant velocity in a fluid. The following data are known at the conditions of interest: viscosity of the fluid = 0.1 Pa.s, acceleration due to gravity = 10 m/s<sup>2</sup>, density of the particle = 1164  $\text{kg/m}^3$  and density of fluid = 997  $\text{kg/m}^3$ . In the Stoke's law regime?

\*\*\*\*\* End of Question Paper \*\*\*\*\*

- Q. 7 (a) With the help of a neat diagram, explain the construction and working of the following mixers:  
 (i) Double arm knedeler, and (ii) Muller Mixer  
 [7]
- (b) In a bowl centrifugal classifier operating at 35 rpm with water ( $\mu = 0.001 \text{ kg/m.s.}$ ). What is the time (in seconds) taken for a particle of diameter 0.001 m and specific gravity 2.7 to traverse a distance of 0.04 m from liquid surface?  
 [4]
- Q. 7 (b) A flat-blade turbine type impeller is installed in a vertical 1.8 m diameter tank which is filled with 48% sodium hydroxide solution to a depth of 1.8 m. The turbine is 60 cm in diameter and is positioned 60 cm from the bottom of the tank. The turbine is operated at 90 rpm. The tank is fitted with four baffles, each having a width of 18 cm. Calculate the power consumption for the mixer.  
 Data: Density of 48% sodium hydroxide  $1450 \text{ kg/m}^3$  and viscosity of the solution 10 cP.  
 The value of power number may be approximated from the following table for  $N_p$  vs  $Re$   
 [8]
- | $Re$  | 30,000 | 50,000 | 70,000 | 80,000 |
|-------|--------|--------|--------|--------|
| $N_p$ | 5.5    | 5.8    | 5.9    | 6      |
- Q. 8 (a) How solids are stored, discuss in detail? Also, discuss about the flow of solids from bins or silos.  
 [16]
- (b) Air carrying particle of density  $1800 \text{ kg/m}^3$  and an average diameter of 20 micrometres a cyclone at linear velocity of 18 m/s. The diameter of cyclone is 600 mm. What is the approximate separation factor for this cyclone?  
 [2]
- Q. 9 (a) Discuss in detail about apron conveyors. What are their merits over belt conveyors?  
 [14]
- (b) What are the advantages and disadvantages of a screw conveyor?  
 [16]

Section C

- (b) In a bowl centrifugal classifier operating at 35 rpm with water ( $\mu = 0.001 \text{ kg/m.s.}$ ). What is the time (in seconds) taken for a particle of diameter 0.001 m and specific gravity 2.7 to traverse a distance of 0.04 m from liquid surface?  
 [4]

- (i) Thermocouples and Resistant thermometers  
(ii) Bourdon gauge and Bellows type gauge pressure measuring device.
- (b) With neat sketch explain construction and working of ultrasonic level detector.

2. (a) What do you understand by the term Control System?

Explain its industrial significance with a suitable example.

(b) Solve the following using Laplace Transforms :

$$\frac{d^2q}{dt^2} + \frac{dq}{dt} = t^2 + 2t \quad q(0) = 4; \quad q'(0) = -2 \quad 6$$

3. (a) Describe the following with the help of one example each :

- (i) Variable area meter  
(ii) Radiation pyrometers.

(b) Match Column I with Column II :

Column I	Column II
(P) Lag	(I) Reproducibility
(Q) Static and dynamic error	(II) Fidelity
(R) Draft	(III) Speed of Response
(S) Sensitivity	(IV) Precision

6. The open-loop transfer function of a control system is given as :

$$G(s) = \frac{K_c}{(s+1)(0.1s+1)}$$

Sketch the asymptotic Bode diagram of the control system.

4. A step change of magnitude 3 is introduced into the transfer function :

$$\frac{Y(s)}{X(s)} = \frac{10}{2s^2 + 0.3s + 0.5}$$

Find :  
(i) Overshoot  
(ii) Period of oscillation  
(iii) Rise time  
(iv) Ultimate value of response  
(v) Maximum value of response.

10

5. (a) For a control system, the characteristic equation is :  
 $s^4 + 4s^3 + 6s^2 + 4s + 1 + K_c = 0$   
(i) Determine the value of  $K_c$  above which the system is unstable.  
(ii) Determine the value of  $K_c$  for which two of the roots are on the imaginary axis and determine the values of these imaginary roots and the remaining two roots.

- 3  
2  
3  
2  
2

(b) Derive the transfer function of two non-interacting liquid level tanks that relate liquid level in second tank to inlet volumetric flow rate. Assume the liquid to be of constant density, the tanks to have uniform cross sectional area and the flow resistances to be linear. 5

pressure of 9 psig. The set point and pen point are initially together. At time  $t = 0$ , the set point is moved away from the pen point at a rate of 0.5 in/min the motion of the set point is in the direction of lower readings. If the knob settings are :

B.Tech. (V Sem.)

CHE 312

$K_c = 2 \text{ psig/in}$  of pen travel

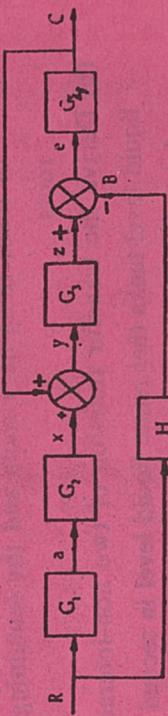
$\tau_i = 1.25 \text{ min}$

$\tau_b = 0.4 \text{ min}$

Plot the output pressure *versus* time.

(b) Explain Proportional, Integral and Derivative controller.  
 Differentiate them according to their functional role.

8. (a) Determine the overall transfer function  $C(s)/R(s)$  for the system shown in figure below : 6



(b) Differentiate between:-

- Positive and Negative
- Servo and Regulator

9. (a) Write in brief about tuning rules :  
 (i) Ziegler-Nichols tuning rules

(b) Explain the application of actuators in control systems.  
Define pneumatic actuator and hydraulic actuator.

100 742 4

PAPER CHE 312—Chemical Process Control

TIME ALLOWED: THREE HOURS

- the system shown in figure below : 6

(b) Differentiate between:-  
 (i) Positive and Negative feedback.  
 (ii) Servo and Regulator problem.

9. (a) Write in brief about tuning rules :  
 (i) Ziegler-Nichols tuning rules  
 (ii) Cohen-Coon tuning rules.

(b) Explain the application of actuators in control systems.

Define pneumatic actuator and hydraulic actuator.

1. (a) Distinguish between the following:-

  1. The question paper is divided into three Sections. Attempt six questions in all, selecting not more than two questions from each Section.
  2. Direct answers or equations without showing proper steps is not allowed.
  3. All parts of a question must be answered at same place.
  4. In case of missing data or incorrect information make appropriate assumption(s) and mention them clearly in answer sheet.
  5. Use of scientific calculator is allowed.
  6. Provide one log-log graph paper and one normal graph paper to students.

SECTION A

## B.Tech. (V Sem.)

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CHE 309

Examination paper has set times of 09.00 hrs & ended  
to 10.00 hrs consisting of 3 sets of three questions each. Each set  
is available to students for 30 minutes.  
No marks will be given for time spent on reading  
questions and

### B.Tech. (FIFTH SEMESTER) EXAMINATION, DECEMBER 2022

#### CHEMICAL ENGINEERING

PAPER CHE 309— Mass Transfer

TIME ALLOWED : THREE HOURS

Time to write answer. Maximum Marks— 60

or continuous bits of answers will not be accepted. In 8  
parts to 3. This question paper has nine questions. Students

are required to attempt six questions in all,

and can now selecting two questions from each section.

in 3 to 10. All questions carry equal marks.

*Note : Attempt all parts of a question at one place. Assume any  
missing data and highlight these in answer sheet and use graph  
paper wherever required. Calculator is allowed.*

#### SECTION A

- (a) Write a short note on analogy between transport  
processes.
- (b) Ammonia gas (A) diffuses through nitrogen gas (B)  
under steady state conditions with nitrogen non-

diffusing. The partial pressure of A at location 1 is  $1.5 \times 10^4$  Pa and that at location 2 is  $5 \times 10^3$  Pa. Locations 1 and 2 are 15 cm apart. The total pressure is  $1.103 \times 10^5$  Pa and temperature is 298 K. Calculate the flux of diffusion of ammonia. Also calculate flux of diffusion

for equimolar counter diffusion assuming that nitrogen

is also diffusing. Take diffusivity at prevailing conditions

$2.30 \times 10^{-5}$  m<sup>2</sup>/s.

#### SECTION B

4. (a) What is minimum liquid-gas ratio in case of gas absorption?

(b) During absorption of carbon tetrachloride from a mixture of air-CCl<sub>4</sub> by an organic oil, the gas and liquid

phase mass transfer coefficients have been estimated to be 0.32 and 5.26 kmol/(hr) (m<sup>2</sup>)(mol fraction), respectively. The equilibrium relation under the operating conditions is given by  $y^* = 20x$ , where  $y$  and  $x$  are mole fractions of CCl<sub>4</sub> in gas and liquid phases respectively. Estimate the overall mass transfer coefficients,  $K_y$  and  $K_x$ .

2. (a) For equimolar counter diffusion show that  $D_{AB} = D_{BA}$ .  
4

(b) A service attendant accidentally spills 50 litres of gasoline, which quickly spreads over a level surface of area 8 m<sup>2</sup>. Estimate the time required for the gasoline to evaporate into the stagnant air above the surface of the liquid. The diffusivity of gasoline in air is 0.65 m<sup>2</sup> h<sup>-1</sup>. The air temperature is 298 K. Evaporation may be assumed to take place through a film of air of 2 m thickness. Vapour pressure of gasoline at 298 K is 76 mm Hg. The density of gasoline is 720 kg m<sup>-3</sup> and the molecular weight of gasoline is 200. The operation takes place at 1 atm pressure.

3. (a) State different theories of mass transfer coefficient and explain any in detail. 5  
(b) A volatile organic compound (C<sub>8</sub>H<sub>10</sub>) costing Rs. 5 a kg is stored in a tank 10 m diameter and open at the top. A stagnant air film 10 mm thick is covering the

surface of the compound beyond which the compound volatilising is absent. If the atmospheric temperature is 25 °C, vapor pressure of compound 150 mm Hg and its molar diffusivity 0.02 m<sup>2</sup>/hr, calculate the loss in Rs./day. 5

#### SECTION B

4. (a) What do you mean by Adsorption Isotherm? How many types of Adsorption Isotherms, discuss in details.

(b) An aqueous solution containing a valuable solute is coloured by small amounts of impurity. Decolourisation experiments of the aqueous solution yielded the following equilibrium relations :  
$$Y^* = 8.91 * 10^{-5} X^{1.66}$$
 where, Y = colour units/kg solution.

$X$  = Colour units/kg adsorbent.

1000 kg of initial solution with colour concentration of 9.6 colour units/kg solution is to be treated in a single stage using 32 kg fresh adsorbent, then calculate the per cent of original colour removed. 5

6. (a) What do you mean by Mass Transfer Zone (MTZ), Breakthrough Curves and Length of Unused bed (LUB)? 5

(b) A solution of washed raw cane sugar is coloured by the presence of small amounts of an impurity. The solution is to be decolourised by treatment with an adsorptive carbon. The original colour has a colour concentration of 9.6 measured on an arbitrary scale and it is desired to reduce colour to 10% of its original value. The data for an equilibrium isotherm are as follows : 5

kg carbon/kg solution 0 0.001 0.004 0.008 0.02 0.04

Equilibrium colour,  
colour units/kg solution 9.6 8.6 6.3 4.3 1.7 0.7

### SECTION C

7. (a) What do you mean by Drying? Write a short note on Rotary Dryers. 5

(b) A commercial dryer requires 6 hours to dry the moist material from 32% to 8% moisture on wet basis. The critical moisture content is 16% (wet) and equilibrium moisture content is 0.05 kg moisture/kg dry solid. How

much excess time is required to dry material from 37% to 7%, if the drying conditions remain the same? 5

8. (a) A batch of wet solids is to be dried from 35% to 10% moisture under constant drying conditions in  $S$  hrs. If the equilibrium moisture content is 12%, estimate the time required to dry the solids to 6% moisture under the same conditions. All moisture contents are on the wet basis. 5

(b) Describe the construction and working principle of "Natural Draft Cooling Tower". 5

9. (a) Write short notes on the following:-

- (i) Relative and Absolute Humidity.
- (ii) Dry and Wet Bulb Temperature.
- (iii) Humid Volume and Humid Heat. 6

(b) Derive expression for Adiabatic Saturation Curve. 4

**B.Tech. (V Sem.)**

**740**

**BT 310**

**B.Tech. (FIFTH SEMESTER)  
EXAMINATION, DECEMBER 2022**

**BIOTECHNOLOGY**

**PAPER BT 310—Microbiology and Immunology**

**TIME ALLOWED : THREE HOURS**

**Maximum Marks—60**

*Attempt six questions in all, selecting two questions from each Section. All questions carry equal marks.*

**SECTION A**

1. Describe the general structure of virus. Explain how animal virus replicates having RNA as the genetic material.  $3+7=10$
2. Explain the conjugation process in bacteria with the help of suitable diagrams.  $3+7=10$
3. Write down the structure of Gram negative bacterial cell wall. Explain the mechanism of peptidoglycan synthesis in detail with suitable diagrams.  $5+5=10$

*Turn over*

## SECTION B

Differentiate between followings:-

Innate immunity and acquired immunity.

Active immunity and passive immunity.  $5+5=10$

Define the term sterilization. Enlist different methods of sterilization. Explain various methods of sterilization briefly.  $2+3+5=10$

Write short note on the following:-

Applications of microorganisms in food industry.

Characteristics of antigens.  $5+5=10$

## SECTION C

Differentiate between the followings:-

Humoral immune response and cell mediated immune response.

CDI and MHC II molecules.  $5+5=10$

Define the term immunity. Explain the structure and function of different immunoglobulins with the help of diagrams.  $10$

Explain the production process and applications of monoclonal antibodies in detail.  $10$

## SECTION B

4. Differentiate between followings:-  
(a) Innate immunity and acquired immunity.  
(b) Active immunity and passive immunity.  $5+5=10$
5. Define the term sterilization. Enlist different methods of sterilization. Explain various methods of sterilization by heat only.  $2+3+5=10$
6. Write short note on the following:-  
(a) Applications of microorganisms in food industry.  
(b) Characteristics of antigens.  $5+5=10$

## SECTION C

7. Differentiate between the followings:-  
(a) Humoral immune response and cell mediated immune response.  
(b) MHC I and MHC II molecules.  $5+5=10$
8. Define the term immunity. Explain the structure and functions of different immunoglobulins with the help of suitable diagrams.  $10$
9. Explain the production process and applications of monoclonal antibodies in detail.  $10$

## B.Tech. (V Sem.)

BT 308

738

Section B

### B.Tech. (FIFTH SEMESTER) EXAMINATION, DECEMBER 2022

BIOTECHNOLOGY

PAPER BT 308— Genetics and Genetic Engineering

TIME ALLOWED : THREE HOURS

Maximum Marks— 60

Attempt six questions in all, selecting two questions from each Section. All questions carry equal marks.

#### SECTION A

1. What are multiple alleles? Describe with suitable examples. 10

2. What is test cross? If the progeny of the cross  $aaBB \times AAbb$  is test crossed, and the following genotypes are observed among the progeny of the test cross, what is the frequency of recombination between these loci?

AaBb 155

Aabb 410

aaBb 370

aabb 140

10

Turn over

3. What is mutagen, their different types and how can it be used for crop improvement? 10

#### SECTION B

4. Describe the gene vector cloning. Explain how dose plasmid vectors differ from phage vector. 10

5. Explain the suitable method of genomic DNA isolation (manually) from plant leaves with the function of Isoamyl alcohol and Isopropanol. 10

6. A scientist wants to insert desire gene to produce stable transgenic line of plant. Which kind of genetic transformations are used, explain in detail with suitable diagram. 10

#### SECTION C

7. Explain one gene one enzyme hypothesis and the latest version of the same hypothesis with the help of appropriate diagrams. 10

8. Explain the type of disease in which maternal gene is affected and probability of disease occurrence in male offspring is 100%, with examples. What are the deferent type of autosomal and sex linked diseases? 10

9. What are the tools of genetic engineering? How are thy used in health and medicine? 10



- (b) A unity gain feedback system has closed loop transfer function as:

$$\frac{C(s)}{R(s)} = \frac{ps + C}{s^2 + qs + C}$$

where  $p$ ,  $q$  and  $C$  are the system parameters. Find the condition for which the steady state error is zero, if unit ramp input is applied to this system.

2. (a) The block diagram of a control system is shown in Fig. 2. Draw the signal flow graph and obtain the transfer function using Mason's gain formula.

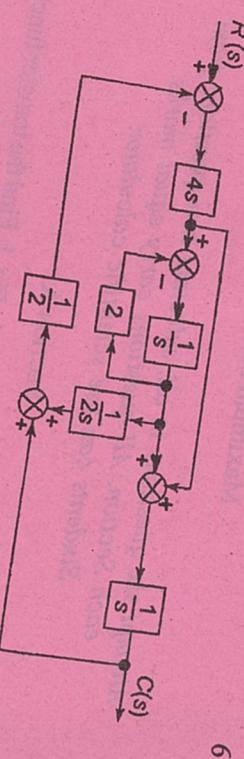


Fig. 2

- (b) Explain the construction and working of synchro control transformer. Also prove that it works as an error detector.

3. (a) The open loop transfer function of a unity gain negative feedback system is given by :

$$G(s) = \frac{K(s+1)}{s(s^2 + 2s + 4)}$$

4. The open loop transfer function of a unity gain negative feedback system is given by :

$$G(s) = \frac{K}{s(sT + 1)}$$

By what factor  $K$  should be multiplied so that the damping ratio is increased from 0.3 to 0.9?

- (b) The Fig. 3 shows a DC field control motor. The  $V_f$  is the input voltage of field winding and  $\theta$  is the angular displacement of the shaft. The inertia of load connected to shaft is  $J$ , the surface friction is  $B$ . Derive the expression of the transfer function of this system.

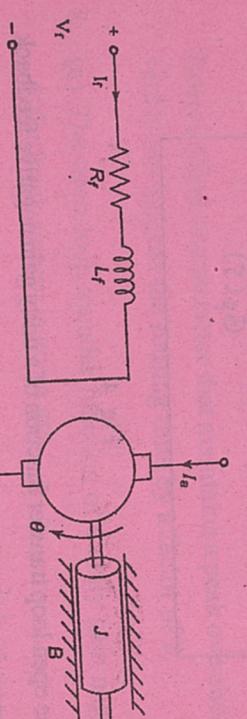


Fig. 3

#### SECTION B

4. (a) The open loop transfer function of a unity gain negative feedback system is given as :

$$G(s) = \frac{K(s+1)}{(s+2)(s^2 + 2s + 4)}$$

- Draw the root locus of the system. Also comment on stability of closed loop system.

- (b) A controller  $G_C(s)$  is cascaded with a DC motor  $G_P(s)$  as shown in Fig. 4. The closed loop transfer function of the system is given as :

$$\frac{C(s)}{R(s)} = \frac{(5s+6)}{(s+3)(s^2 + s + 2)}$$

Identify the controller and comment on the system performance.

4

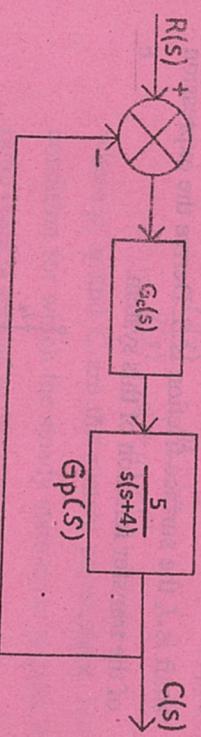


Fig. 4

5. The open loop transfer function of a unity gain negative feedback system is given as:-

$$G(s) = \frac{(12 - 6s)}{(s+1)(s+5)}$$

Draw the Nyquist plot and find stability parameters of the system. Also comment on system stability.

10

6. (a) "For a second order system, the phase margin depends on the damping ratio." Mathematically prove this statement.

4

- (b) The open loop transfer function of a unity gain negative feedback system is given as :

$$G(s) = \frac{K + 60s}{s^2(s^2 + 6s + 30)}$$

- (i) Determine the range of  $K$  for which the system is stable.

- (ii) Determine the range of  $K$  for which all closed loop poles lie on left half of  $s = -1$ .

7. A negative unity gain feedback system has plant transfer function as :

$$G(s) = \frac{K}{s(s+8)}$$

Design a lead compensator that maintains a peak overshoot of 16.5% but reduces the settling time by a factor of 2.

10

8. (a) The open loop transfer function of a unity gain negative feedback system is given as :

$$G(s) = \frac{20(1 + 0.125s + 0.015625s^2)}{s^2(2s+1)}$$

Draw the Bode plot for this system. Determine the phase crossover frequency, gain crossover frequency, gain margin and phase margin. Also comment on stability of the system.

- (b) The open loop transfer function of a unity gain negative feedback system is given by :

$$G(s) = \frac{\omega_n^2}{s(s + 2\xi\omega_n)}$$

Derive the expression of bandwidth of the system.

3

9. (a) The state equation of a LTI system is given by :

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -1 & -2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u$$

$$y = \begin{bmatrix} 1 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$$

9. The circuit of second order low-pass filter is shown in Figure 5.

Determine the transfer function when  $R_2 \neq R_3$  and  $C_2 \neq C_3$ .

Suppose  $R_1 = 22 \text{ k}\Omega$ ,  $R_3 = 30 \text{ k}\Omega$ ,  $C_2 = 100 \text{ pF}$  and  $C_3 = 200 \text{ pF}$ .

Draw the frequency response curve for this condition. 5+5

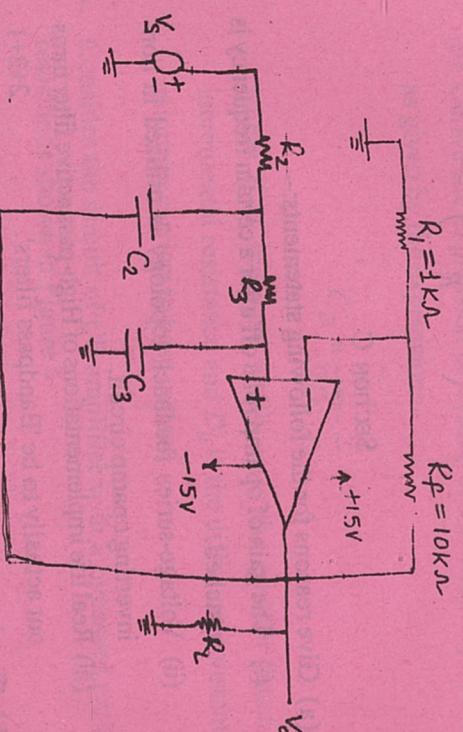


Figure 5

## B.Tech. (EIE/EEE/MCTR) (FIFTH SEMESTER) EXAMINATION, DECEMBER 2022

ELE 311

### PAPER ELE 311— Analog Integrated Circuits

TIME ALLOWED : THREE HOURS  
Maximum Marks— 60

Attempt six questions in all, selecting two questions from each Section. Assume missing data, if any, suitably.

Illustrate your answers with neat sketches wherever necessary. All questions carry equal marks.

#### SECTION A

- (a) Design a feedback amplifier topology in which the input connection is like a shunt and the output connection is like a series. Also determine the input resistance with feedback ( $R_{if}$ ) and output resistance with feedback ( $R_{of}$ ) for the same. 5
- (b) Calculate the input power, output power and efficiency of the power amplifier circuit in the following Figure 1 for an input voltage that results in a base current of 20 mA peak and  $\beta = 20$ . 5

(MOSFET) CLASS-B AMPLIFIER

Ques. 8 (b) Prove that the maximum efficiency of class-B push-pull power amplifier at the point of maximum power dissipation is 50%.

5. Consider the circuit as shown in Figure 3.

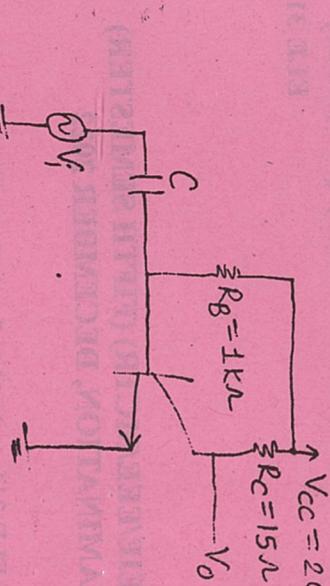


Figure 1

2. (a) For the circuit shown in Figure 2, determine the type of feedback topology. Obtain the transresistance gain with feedback ( $R_{vf}$ ), voltage gain with feedback ( $A_v$ ), input resistance with feedback ( $R_i$ ) and output resistance with feedback ( $R_o$ ). The transistor parameters are  $h_n = 1 \text{ k}\Omega$  and  $h_e = 100$ . Assume  $h_{re} = h_{oe} = 0$ . Given that  $R_s = 1 \text{ k}\Omega$  and  $R_f = 100 \text{ }\Omega$ .

5

$$R_{vf} = R_i + \frac{R_i R_f}{R_f + R_i + R_i A_v}$$

where  $R_i$  is the input resistance of opamp,  $A_v$  is the open loop gain and  $R_f$  is the input resistance with feedback.

#### SECTION B

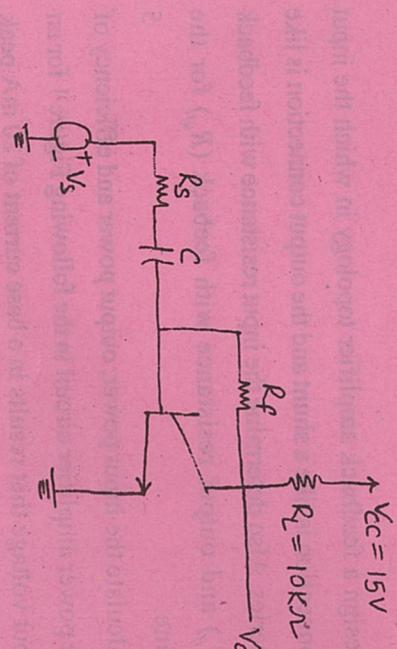


Figure 2

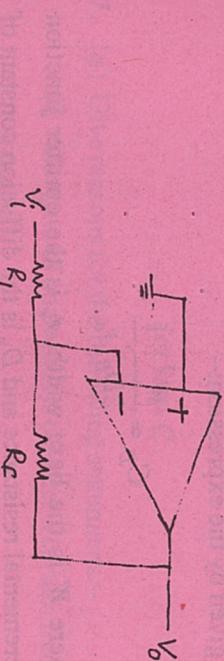


Figure 3

- (a) Identify the feedback topology in the above circuit.

- (b) Draw the equivalent circuit (low frequency model) by considering open loop gain ( $A_v$ ) and applying Miller's theorem.

- (c) Prove that :

$$|A_{iso} F_H| = \frac{f_T}{1 + 2\pi f_T C_C R_K} \cdot \left( \frac{R_S}{R_S + r_{bb}} \right)$$

5. (a) Explain the working and frequency response of a RC coupled transistor amplifier (two-stage) with necessary diagrams and equations. Give the reason for the reduction

5

$$\frac{A_v}{A_0} = \frac{1 + j\omega C_z R_e}{\left(1 + \frac{R'}{R}\right) \cdot \frac{1 + j\omega C_z R_e}{1 + \frac{R'}{R}}}$$

SECTION C

- diagrams and equations.....

in gain at low and high frequencies.

(b) Derive the expression of hybrid - $\pi$  diffusion capacitance as given by the expression:-

$$C_D = \frac{W^2}{2D_B} \cdot \frac{1}{r_e}$$

where  $W$  is the base width,  $r_e$  is the emitter junction incremental resistance and  $D_B$  is the diffusion constant of minority carriers in base region.

6. Consider the circuit of CE amplifier with a bypassed emitter resistor as shown in Figure 4.

resistor as shown in Figure 4.

- (iii) Real life implementations of High-pass active filter turns out actually to be 'Bandpass filters'. 2+2+1

(b) Sketch an operational amplifier circuit having the following inverting opamp circuit.

$$V_0 = - \int_0^t (V_1 + 2V_2 + 10V_3) dt$$

Also find the component values if the integrating capacitor is  $C = 1 \mu F$ . Assume ideal opamp.

3+2

8. (a) A differential amplifier using BJT has  $R_C = 10 \text{ k}\Omega$ ,  $R_E = 14.3 \text{ k}\Omega$ ,  $V_{BE} = 0.7 \text{ V}$ ,  $V_T = 26 \text{ mV}$ ,  $I_C = 0.5 \text{ mA}$ . Assume supply voltages of +15 V and -15 V. Output ( $V_o$ ) is taken from one of the collectors and input ( $V_i$ ) to one of the bases with other base grounded. Determine differential gain, common-mode gain and CMRR.

(b) Design a symmetrical square waveform generator of 10 kHz frequency.

Figure 4

Draw the low frequency 4-parameter model for the above circuit and show that :

300

732

turns per phase is 15. Calculate the secondary line voltage, line current and output for the following connections : (i) mesh-mesh, (ii) star-star, (iii) mesh-star, and (iv) star-mesh.

- (b) Write short notes on following:-

  - Scott connector or T-T connection
  - Open delta or V-V connection
  - Tertiary winding in transformer.

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- current and output for the following connections : (i) mesh-mesh, (ii) star-star, (iii) mesh-star, and (iv) star-mesh.

(b) Write short notes on following:

- Based on following:-

  - (i) Scott connector or T-T connection
  - (ii) Open delta or V-V connection
  - (iii) Tertiary winding in transformer

2

PAPER EEE 306— Electrical Machines

**TIME ALLOWED : THREE HOURS**  
**Maximum Marks— 60**

question paper as ...  
question paper as ...

## SECTION A

- (a) Self and mutual inductances

$$L_{11} = 3 + \frac{1}{2x}, L_{22} = 2 + \frac{1}{2x}, L_{12} = \frac{1}{2x}$$

where  $x$  is a certain linear displacement. For currents of 10 amp and -5 amp determine :

  - time average force at  $x = 0.5$  mt
  - the mechanical work done in increasing  $x$  from 0 to 1 mt
  - the electrical energy supplied by each electrical source

$$L_{11} = 3 + \frac{1}{2x}, L_{22} = 2 + \frac{1}{2x}, L_{12} = \frac{1}{2}$$

where  $x$  is a certain linear  $\alpha$ .

currents  $U_1$  and  $U_2$

- (ii) the mechanical work done in increasing the mass of a body by 1 kg  
(iii) the electrical energy supplied by each electrical source to 1 m<sup>2</sup>

Turn over

- (iv) the change in magnetic field energy in part (ii).  
 (b) For a singly-excited magnetic system, establish relationship between magnetic field energy and coenergy. What is the significance of coenergy? Show that the field energy in a linear magnetic system is given by :

$$W_f = \frac{1}{2} L i^2 = \frac{1}{2} \psi i = \frac{1}{2L} \psi^2$$

2. (a) In a doubly-excited rotary machine the inductance coefficients are :

$$L_{11} = (1.1 + 0.4 \cos 2\theta); L_{22} = (0.33 + 0.005 \cos 2\theta);$$

$$L_{12} = 0.2 \cos \theta$$

The exciting currents are  $i_1 = 8$  amp and  $i_2 = 50$  amp. Obtain the torque/angular displacement relation. Derive the expression used, if any.

- (b) Derive an expression for the torque in a doubly-excited system having salient pole type of stator as well as rotor. State the assumptions made. Hence show that differential changes of currents do not contribute to the production of magnetic torque.

3. (a) Derive an expression for reluctance torque in a rotating electrical machine.  
 (b) Two coils have self and mutual inductance of

$$L_{11} = L_{22} = \frac{2}{(1+2x)}$$

$$L_{12} = \frac{1}{1+2x}$$

- (iv) Calculate the time-average force and coil currents at  $x = 0.5$  mif:

- (i) both the coils are connected in parallel across a voltage source of  $100 \cos 314t$ , and  
 (ii) coil 2 is shorted while coil 1 is connected across a voltage source of  $100 \cos 314t$ , and

- (iii) the two coils are connected in series across a voltage source of  $100 \cos 314t$ .

## SECTION B

4. (a) Draw a neat sketch of a DC generator. State the function of each part. Derive the emf equation of a generator.  
 (b) Hopkinson's test is performed on two identical DC shunt machines. The data related to this test are as follows :

$$\text{Supply voltage} = 200 \text{ V}$$

$$\text{Line current} = 110 \text{ A}$$

$$\text{Armature current of the motor} = 510 \text{ A}$$

$$\text{Field current of the motor} = 4 \text{ A}$$

$$\text{Field current of the generator} = 3 \text{ A}$$

$$\text{Armature resistance of the motor} = 0.08 \Omega$$

$$\text{Armature resistance of the generator} = 0.09 \Omega$$

$$\text{Brush drop} = 1 \text{ V per brush}$$

- Calculate the efficiency of each machine.

5. (a) A 220 V, 7.5 kW series motor is mechanically coupled to a fan. When running at 400 rpm the motor draws 30 A from the mains 220 V. The torque required by the fan is

proportional to the square of speed.  $R_o = 0.6 \Omega$ ,  $R_{se} = 0.4 \Omega$  neglect armature reaction and rotational loss. Also assume the magnetisation characteristic of the motor to be linear.

- (i) Determine the power delivered to the fan and torque developed by the motor.
- (ii) Calculate the external resistance to be added in series to the armature circuit to reduce the fan speed to 200 rpm.

Calculate also the power delivered to the fan at this speed.

- (b) Explain the following three characteristics :

- (i) Speed versus armature current characteristics  
(ii) Torque versus armature current characteristics  
(iii) Speed versus torque characteristics for (a) DC shunt motor, (b) DC series motor, (c) DC compound motor.

6. (a) A 220 V compound generator is supplying a load of 100 A at 220 V. The resistance of its armature, shunt and series

windings are  $0.1 \Omega$ ,  $50 \Omega$  and  $0.06 \Omega$  respectively. Find the induced e.m.f. and the armature current when the machine is connected (i) short shunt, (ii) long shunt, (iii) how will the series amp-turns be changed in (ii) if a divertor of  $0.14 \Omega$  is connected in parallel with the series winding? Neglect armature reaction and brush contact drop.

- (b) The input to 230-V, d.c. shunt motor is 11 kW. Calculate (i) the torque developed, (ii) the efficiency, (iii) the speed at

this load. The particulars of the motor are as follows :

No-load current = 5 A; No-load speed = 1150 r.p.m.  
Armature resistance =  $0.5 \Omega$ ; shunt field resistance =  $110 \Omega$ .

### SECTION C

7. (a) Explain the working principle of a single-phase transformer and explain how the equivalent circuit of a working transformer is developed by doing away with each of the ideal conditions one by one.

- (b) A 600 kVA, 1-phase transformer has an efficiency of 92% both at full-load and half-load at unity power factor. Determine its efficiency at 60% of full-load at 0.8 power factor lag.

8. (a) Two 1-phase transformers with equal turns have impedances of  $(0.5 + j3)$  ohm and  $(0.6 + j10)$  ohm with respect to the secondary. If they operate in parallel, determine how they will share a total load of 100 kW at p.f. 0.8 lagging.

- (b) A transformer has its maximum efficiency of 0.98 at 15 kVA at unity p.f. During a day, it is loaded as follows :

12 hours : 2 kW at 0.8 p.f  
6 hours : 12 kW at 0.8 p.f  
6 hours : 18 kW at 0.9 p.f

Find the all day efficiency.

9. (a) A three-phase step-down transformer is connected to 6600 V mains and draws a current of 10 A. The ratio of the

## B.Tech. (V Sem.)

731

STAT 204

### B.Tech. (FIFTH SEMESTER) EXAMINATION, DECEMBER 2022 (EC/MT/CE/BT/EI/EE)

#### PAPER STAT 204—Probability and Statistical Methods

TIME ALLOWED : THREE HOURS

Maximum Marks— 60

The question paper is divided into three Sections. Attempt six questions in all, selecting two questions from each Section. All questions carry equal marks.

#### Section A

1. (a) One shot is fired from each of the three guns. If the probability that the target is hit by the first, second and third guns is 0.5, 0.6 and 0.8, respectively. Find the probability that (i) exactly one hit is registered, and (ii) at least two hits are registered.  
(b) The probability that a construction job will be finished on time is  $3/5$ ; the probability that there will be no strikes is  $2/3$ , and the probability that the job will be finished on time given that there are no strikes is  $4/5$ . Find the probability that the job will be finished on time and there will be no strikes. What is the probability that there have been no strikes given that the job is finished on time?  
2. (a) A continuous r.v.  $X$  follows the probability law:  $f(x) = ax^2$ ,  $0 \leq x \leq 1$ . Determine  $a$  and find the probability that (i)  $X$  is less than 0.4, (ii)  $X$  lies between 0.2 to 0.5 and (iii)  $X > 3/4$  given  $X > 1/2$ .  
(b) A random variable  $X$  has the following probability distribution

x	0	1	2	3	4	5	6	7	8
$F(x)$	$k$	$3k$	$5k$	$7k$	$9k$	$11k$	$13k$	$15k$	$17k$

Determine the value of  $k$ . What is the smallest value of  $x$  for which  $P[X \leq x] > 0.5$ ? Also, find the expectation and variance of  $X$ .

3. (a) Two discrete random variables  $X$  and  $Y$  have:  $P[X = 0, Y = 0] = 2/9$ ;  $P[X = 0, Y = 1] = 1/9$ ,  $P[X = 1, Y = 0] = 1/9$ ; and  $P[X = 1, Y = 1] = 5/9$ . Examine whether  $X$  and  $Y$  are independent.  
(b) Two random variables  $X$  and  $Y$  have the following joint probability density function:  
$$f(x, y) = \begin{cases} k(4 - x - y) & 0 \leq x \leq 2; 0 \leq y \leq 2 \\ 0 & \text{otherwise} \end{cases}$$

Find the constant  $k$  and conditional expectation of  $X$  given  $Y$ .

## Section B

B.Tech (V Sem.)

4. (a) Given the following frequency distribution of  $(X, Y)$ , find the correlation coefficient.

Y	X	
	5	10
10	30	20
20	20	30

What shall be the relationship between the correlation coefficients between  $X, Y$  and  $U, V$ , where  $U = \frac{X-7.5}{2.5}$ ,  $V = \frac{Y-15}{5}$ ?

- (b) Compare and contrast the roles of correlation and regression in studying the inter-dependence of two variates. For 10 observations on price ( $X$ ) and supply ( $Y$ ), the following data were obtained (in appropriate units):

$$\sum X = 130, \quad \sum Y = 220, \quad \sum X^2 = 2288, \quad \sum Y^2 = 5506 \quad \text{and} \quad \sum XY = 3467.$$

Obtain the line of regression of  $Y$  on  $X$  and estimate the supply when the price is 16 units.

5. (a) From the heights ( $X_1$ ), weights ( $X_2$ ) and ages ( $X_3$ ) of a group of students the following standard deviations and correlation coefficients were obtained:  $\sigma_1 = 2.8$  inches,  $\sigma_2 = 12$  lbs, and  $\sigma_3 = 1.5$  years,  $r_{12} = 0.75$ ,  $r_{23} = 0.54$ , and  $r_{31} = 0.43$ . Calculate  $R_{213}$ ,  $r_{12.3}$  and  $r_{13.2}$ . Also, interpret the results.

- (b) It is stated that 3% of scissors supplied by a manufacturer are defective. A random sample of 200 scissors is drawn from a lot. Find the probability that (i) 2 or more are defective, and (ii) 3 or less are defective.

6. (a) Define normal distribution. The life-time in hours of a certain electrical equipment has the normal distribution with mean=80 and standard deviation=16. What is the probability that the equipment lasts at least 100 hours? If the equipment has already lasted 88 hours, what is the probability that it will last at least another 12 hours?

- (b) A set of 5 coins was thrown 3125 times and the number of heads appearing in each throw was recorded as in the following table.

No. of heads:	0	1	2	3	4	5
Frequency:	32	225	710	1120	820	218

Calculate theoretical frequency of each number of heads on the assumption that the binomial law holds.

## Section C

7. (a) A storekeeper wanted to buy a large quantity of light bulbs from two brands labeled 'A' and 'B'. He bought 100 bulbs from each brand and found by testing that brand A had mean lifetime of 1120 hours and the standard deviation of 75 hours; and brand B had mean lifetime of 1062 hours and standard deviation of 82 hours. Examine whether the difference of means is significant?
- (b) Eleven school boys were given a test in Statistics. They were given a month's tuition and a second test was held at the end of it. Do the marks give evidence that the students have benefited by the extra coaching?

Boys	1	2	3	4	5	6	0	11
Marks in First Test	23	20	19	21	18	20	18	20
Marks in Second Test	24	19	22	18	20	22	22	21

8. (a) In a simple sample of 600 high school students from a State found to use dot pens. In one of 900 from a neighboring State, 450 are dot pens. Do the data indicate that the States are significantly different with respect to the habit of using dot pens among the students?
- (b) A bird watcher sitting in a park has spotted a number of birds belonging to 6 categories. The exact classification is given below:

Category:	1	2	3	4	5	6
Frequency:	6	7	13	17	6	5

Test at 5% level of significance whether or not the data agree with the assumption that this particular park is visited by birds belonging to six categories in the proportion 1:1:2:3:1:1.

9. (a) On a particular proposal of national importance, Democrats and Republicans cast their votes as shown in the following table. At 5% level of significance, test the hypothesis that there is no difference between the two parties as this proposal is concerned.

	In Favor	Opposed	Undecided
Democrats	85	78	
Republicans	118	61	

- (b) A consumer agency wanted to find out if the mean time taken by each of three brands of medicines to provide relief from a headache is the same. The first drug was administered to six randomly selected patients, the second to four randomly selected patients, and the third to five randomly selected patients. The following table gives the time (in minutes) taken by each patient to get relief from a headache after taking the medicine.

Drug I	Drug II	Drug III
25	15	44
38	21	39
42	19	54
65	25	58
47		73
52		

At the 1% significance level, will you conclude that the mean time taken to provide relief from a headache is the same for each of the three drugs?

#### Supplementary Material: Tabulated values

d.f.	1%	5%	10%	
t	10	3.17	2.23	1.81
t	20	2.85	2.09	1.73
t	22	2.82	2.07	1.72

	d.f.	1%	5%	10%
$\chi^2$	5	15.086	11.70	9.236
$\chi^2$	6	16.812	12.92	10.645
F	(2,12)	99.42	141	9.41
F	(3,15)	26.87	27	5.20

- (b) Derive the expression for the CE short circuit current gain  $A_v$ , as a function of frequency using hybrid- $\pi$  model.

5

8. (a) Derive the relationship between low-frequency  $h$ -parameters and high frequency hybrid- $\pi$  parameters for a transistor in CE configuration.
- (b) What is the physical origin of the two capacitors in the hybrid- $\pi$  model?

2

- (c) A BJT has  $g_m = 38 \text{ mhos}$ ,  $r_{be} = 5.9 \text{ k}\Omega$ ,  $h_{ie} = 6 \text{ k}\Omega$ ,  $r_{bb'} = 100 \text{ }\Omega$ ,  $C_{be} = 12 \text{ pF}$ ,  $C_{bb'} = 63 \text{ pF}$ , and  $h_r = 224$  at 1, kHz. Calculate the  $\alpha$  and  $\beta$  cut-off frequencies and  $f_T$ .

2

9. (a) A single stage CE amplifier is measured to have a voltage gain bandwidth  $f_H$  of 5 MHz with  $R_L = 500 \text{ }\Omega$ . Assume  $h_{re} = 100$ ,  $g_m = 100 \text{ mA/V}$ ,  $r_{bb'} = 100 \text{ }\Omega$ ,  $C_C = 1 \text{ pF}$  and  $f_T = 400 \text{ MHz}$ . (i) Find the value of source resistance that will give the required bandwidth. (ii) With the value of  $R_s$  found in (i), find the midband voltage gain  $V_o/V_s$ .

5

- (b) In hybrid  $\pi$  model of a transistor at high frequencies, show that the  $g_m$  is proportional to the collector current.

5

## Tech. (V Sem.)

ELE 310

### B.Tech. (FIFTH SEMESTER) EXAMINATION, DECEMBER 2022

#### ELECTRONICS AND COMMUNICATION ENGG.

PAPER ELE 310— Analog Electronics

TIME ALLOWED : THREE HOURS

Maximum Marks— 60

*Attempt six questions in all, selecting two questions from each Section. All the necessary information/data are given with the questions. If any information/data is found missing then assume the conventional/usual. Please state your assumptions before answering.*

#### SECTION A

1. (a) Consider the circuit as given below in fig (1). The specifications are given for the dual input, unbalanced output differential amplifier :  $R_C = 2.2 \text{ k}\Omega$ ,  $R_B = 4.7 \text{ k}\Omega$ ,  $R_{in1} = R_{in2} = 50 \text{ }\Omega$ ,  $+V_{cc} = 10 \text{ V}$ ,  $-V_{EE} = -10 \text{ V}$ ,  $\beta_{dc} = 100$  and  $V_{BE} = 0.715 \text{ V}$ . Determine the voltage gain, input resistance and the output resistance.

5

Turn over

- (c) The circuit shown in fig. (4) is a differential amplifier using an ideal op-amp. Find the output voltage  $V_o$ . 3

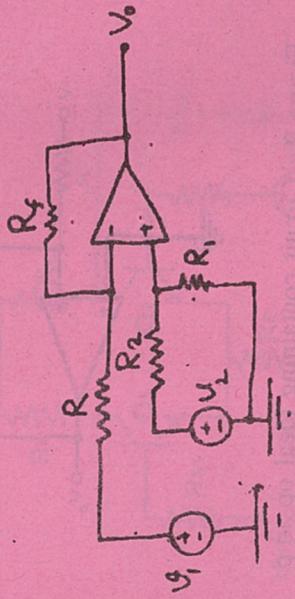


Figure 4 : Differential Amplifier

5. (a) Sketch a regenerative comparator system and explain its operations.

(ii) What parameters determine the loop gain?

(iii) What parameters determine the hysteresis?

(iv) Sketch the transfer characteristic and indicate the hysteresis. 6

- (b) Calculate the voltage  $V_{ut}$  and  $V_{th}$  for given circuit of fig (6).

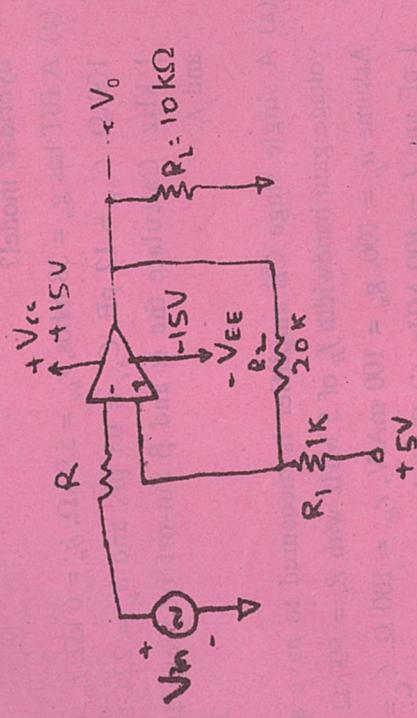


Figure 6 : Circuit containing an op-amp

6. (a) Why is a regulated power supply needed? How is the short circuit protection circuit different from the foldback current limiting circuit?

- (b) The circuit shown in the fig (5) has an ideal op-amp. Find the oscillation frequency and the condition to sustain the oscillations. 6

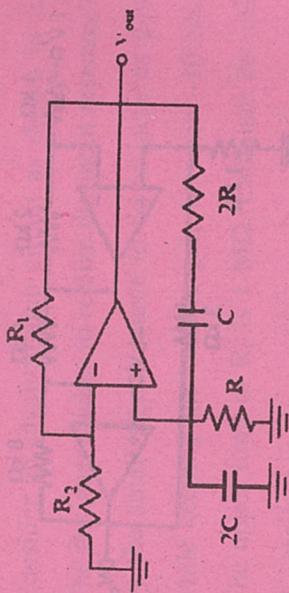


Figure 5 : An oscillator Circuit

6. (a) How does PLL work? Illustrate the performance factor of PLL and Integrated Circuit PLL 565. 5

- (b) With the help of a neat diagram explain the operation of monostable multivibrator using 555 IC. 5

### SECTION C

7. (a) Illustrate the effect of emitter bypass capacitor on low frequency response of an RC-coupled stage. 5

Turn over

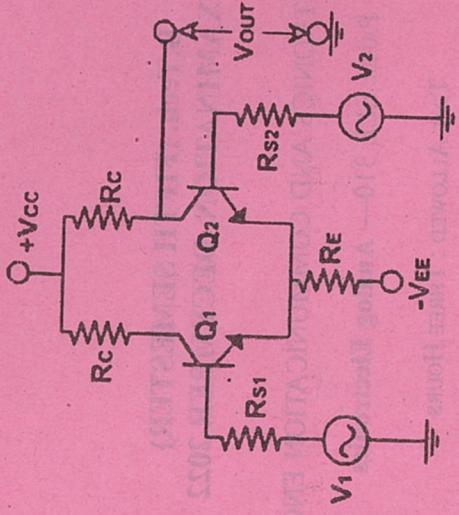


Figure 1 : Dual input, unbalance-output differential amplifier

- (b) State the problems of the basic integrator. How can these problems be corrected in the practical integrator? Explain your answer with the frequency response curve.
- 5

2. (a) Consider an ideal-op-amp circuit as shown in fig (2). The designer wishes to realize the input resistance seen by the small signal source to be as large as possible, while keeping the voltage gain between -10 and -25. (b) The upper limit of  $R_F$  is  $1 \text{ M}\Omega$ . Calculate the value of  $R_i$ , resistance.
- 2

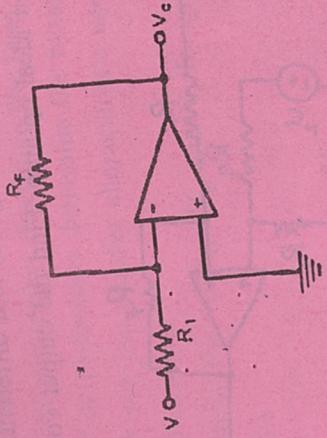


Figure 2 : Circuit containing ideal op-amp  
 (b) Why is instrumentation amplifier preferred over difference amplifier? Obtain the expression for the output voltage of instrumentation amplifier using transducer bridge.

5

3. (a) Design a second order LPF in Butterworth type to have unity gain and cut-off frequency of  $800 \text{ Hz}$ , and maximally flat response.
- 4
- (b) Determine the output voltage for the given circuit in fig (3). Assume ideal conditions.
- 3

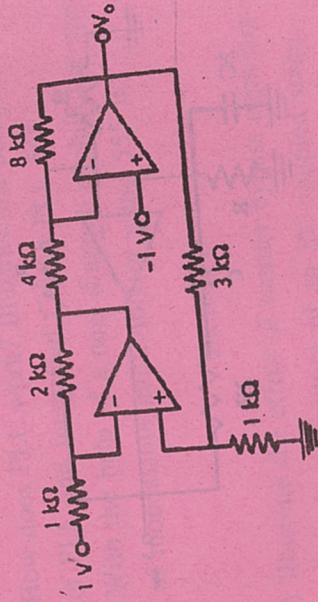


Figure 3 : Circuit containing ideal op-amp

3

- in the same segment and store the result at 0700H in the same segment.
3. (a) Define logical and physical address. Describe physical address generation process in 8086. Calculate physical address by taking CS : 2050H and IP : 0045H. 6
- (b) What is pipelining? How does it improve the processing speed?

#### SECTION B

4. (a) Sketch and explain the interface of  $32K \times 16$  'RW memory using a decoder in minimum mode. 6
- (b) What are the steps in interfacing peripherals with the microprocessor? 4
5. Explain the need for DMA and model of DMA transfer typically made use of by the DMA controller IC-8257. 10
6. (a) Interface 8086 microprocessor with seven segment display in common anode configuration. Also write the instructions for communication. 6
- (b) Discuss the modes of 8255 chip. 4

#### SECTION C

7. (a) Draw and discuss the internal architecture of 8051 microcontroller. 5
- (b) 5 bytes are stored at external data RAM from address 1000H. Store these data in internal RAM from starting address 30H. 5
8. (a) Explain the TMOD and TCON register of 8051 microcontroller. 5
- (b) Write a program to generate a square wave of frequency 2 kHz through port P1.0 by timer 0 of 8051 microcontroller. 5
9. (a) Name five interrupt sources of 8051 microcontroller and specify their respective vector address and their priority level after reset. Also explain how the interrupts can be enabled or disabled. 5
- (b) Draw and explain the timer structure of 8051 with its relevant register. 5



# B.Tech. (EC) (V Sem.) / M.Sc.(Ele.) (III Sem.)

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ELE 301

## B.Tech. (EC) (FIFTH SEMESTER) / M.Sc. (Ele.) (III Sem.) EXAMINATION, DECEMBER 2022

### PAPER ELE 301—Analog Communication

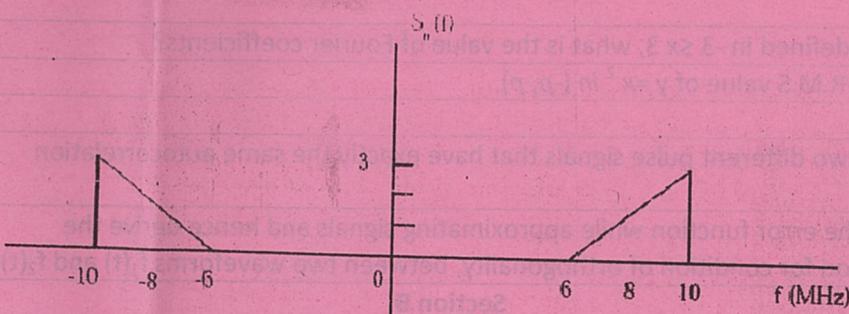
TIME ALLOWED : THREE HOURS

Maximum Marks— 60

Attempt six questions in all, selecting two questions from each Section.

All questions carry equal marks.

Section A		
Q1a	Find the Fourier series coefficients for $x(t) = A \cos \omega t$	3
b	Discuss the Orthogonal Signal Space and obtain the expression for mean signal error	2
c	Find the Fourier transform of a symmetric rectangular pulse of width $\tau$ and height $A$ . Sketch its phase spectrum	5
Section B		
Q2a	State Dirichlet's conditions for a function to be expanded as a Fourier series.	2
b	Find the constant term $a_0$ in the Fourier series corresponding to $f(x) = x - x^3$ in $(-\pi, \pi)$ .	3
c	If $f(x)$ is defined in $-3 \leq x \leq 3$ , what is the value of Fourier coefficients?	3
d	Find the R.M.S value of $y = x^2$ in $(-p, p)$ .	3
Q3a	Specify two different pulse signals that have exactly the same autocorrelation function	5
b	Define the error function while approximating signals and hence derive the expression for condition of orthogonality, between two waveforms $f_1(t)$ and $f_2(t)$ .	5
Section B		
Q4a	An AM signal has the form $u(t) = [20 + 2 \cos 3000 \pi t + 10 \cos 6000 \pi t] \cos(2 \pi f_c t)$ where $f_c = 105$ Hz. 1. Sketch the (voltage) spectrum of $u(t)$ . 2. Determine the power in each of the frequency components. 3. Determine the modulation index.	6
b	From the expression for the instantaneous voltage of an AM wave, derive the formula for the RMS value of this wave.	4
Q5a	The message signal $m(t) = 2\cos 400t + 4 \sin(500t + \pi/3)$ modulates the carrier signal $c(t) = A \cos(8000 \pi t)$ , using DSB amplitude modulation. Find the time domain and frequency domain representation of the modulated signal and plot the spectrum (Fourier transform) of the modulated signal. What is the power content of the modulated signal?	6
b	In a phase shift SSB system, the phase shift at the audio frequency of 500 Hz is only 88°. To what extent will this frequency be present in the unwanted lower side band?	4

<b>Q6a</b>	A 360W carrier is simultaneously modulated by two sine waves with modulation percentage of 55 and 65 respectively. What is the total side band power radiated?	3
	Compare the three main systems of SSB generation by drawing up table of the outstanding characteristics of each system.	4
	In a phase shift SSB system, the phase shift at the audio frequency of 500 Hz is only 88°. To what extent will this frequency be present in the unwanted lower side band?	3
<b>Section C</b>		
<b>Q7a</b>	Derive expression for SNR Calculations in DSBSC System	5
<b>b</b>	A geostationary satellite is located at a distance of 40,000km from an Earth station. At the satellite a source at a frequency of 4 GHz radiates a power of 10 watts through an antenna with a gain of 20 dB. Assume that the effective aperture area of the receiving antenna is 10 m <sup>2</sup> . Calculate the received signal power. ignoring non ideal losses in the links.	5
<b>Q8a</b>	Derive an expression for the post-detection signal-to-noise ratio of the coherent receiver, assuming that the modulated signal is produced by sinusoidal modulating wave. Perform your calculation for the following two receiver types: (a) Coherent DSB-SC receiver (b) Coherent SSB-SC receiver	10
<b>Q9a</b>	Define white noise and plot the power spectral density (PSD) and auto correlation function (ACF) of white noise.	6
<b>b</b>	A bandpass noise signal $n(t)$ can be expressed as $n(t) = n_c(t) \cos\omega_ct + n_s(t)\sin\omega_ct$ . Consider bandpass noise $n(t)$ having the power spectral density shown below in Fig.. Draw the power spectral density of $n_s(t)$ if the center frequency $\omega_c/2\pi$ is 8 MHz	4
 <p>Power spectral density of <math>n(t)</math>.</p>		

<b>a</b>	Plot the expression for the magnitude of the complex envelope of the received signal.	3
<b>b</b>	The message signal $m(t) = 3\cos(400t + 4\sin(250t + 8))$ is modulated onto a carrier sine wave $A(t) = A_0\cos(\omega_0 t)$ . Find the power spectral density of the modulated signal.	6
<b>c</b>	Value of 200 Hz is given to the upper side band in the question. The power spectral density of the modulated signal is $S_m(f) = 200\delta(f - 200) + 100\delta(f + 200)$ . Find the power spectral density of the modulated signal.	4
<b>d</b>	Value of 200 Hz is given to the upper side band in the question. The power spectral density of the modulated signal is $S_m(f) = 200\delta(f - 200) + 100\delta(f + 200)$ . Find the power spectral density of the modulated signal.	4

2. The price elasticity of demand measures how much the quantity demanded responds to changes in the price. Suppose price of a commodity falls to Rs. 8 per unit from Rs. 10 per unit, demand increases from 80 to 100. What is the value of price elasticity of demand on the basis of total expenditure method?

Also explain the degrees of price elasticity of demand. 10

3. "Economics is everywhere, and understanding economics can help you make better decisions and lead to a happier life." Do you agree with this statement? Is economics important for engineers as well? Explain role and scope of engineering economics.

10

#### SECTION B

from the machinery project are given below :

Years : 1 2 3 4 5

Net cash flow : 20,000 55,000 55,000 45,000 35,000

Suppose the firm can borrow investment funds at 10 per cent annual rate of interest. Whether the firm should undertake the project?

10

4. The returns to scale reflect the impact on output of a balanced increase in all inputs. Explain what is meant by :  
(a) constant returns to scale,  
(b) increasing returns to scale  
(c) decreasing returns to scale.

10

Explain briefly how each of these might arise. (a) (b)

5. Perfect competition is found when no firm is large enough to affect the market price. In the light of this statement find out under what conditions a firm will exit a market. Does a firm's price equal marginal cost in the short-run, in the long run, or both? Explain.

10

6. Draw the marginal cost and average total cost curves for a typical firm. Explain why the curves have the shapes that they do and why they cross where they do. How and why does a firm's average total cost curve differ in the short run and in the long run?

#### SECTION C

7. A building site for a new gasoline station was purchased 10 years ago for 50,000. The site has been recently sold for 1,20,000. Disregarding any taxes, determine the rate of interest obtained on the initial investment.

10

8. Suppose a firm is planning to invest in a machine project which costs capital expenditure equal to Rs. 1,60,000. Net cash flows

of time. Also their remaining useful life also keeps on decreasing

## B.Tech.(V Sem.)

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ECO 307

is to over a period of time. Also their remaining useful life also keeps on decreasing with the passage of time. Keeping in mind the above explain the straight line and declining balance depreciation methods.

(Ans)   
Q1

C orage

Q1 In starting year cost of plant A is Rs. 1,00,000. It is to be depreciated by straight line method over a period of 10 years. At the end of 10 years its value is Rs. 10,000. Calculate the annual depreciation.

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Q1

1. Classify the following topics as relating to microeconomics or macroeconomics:

- (a) A family's decision about how much income to save
  - (b) The effect of government regulations on auto emissions
  - (c) The impact of higher savings on economic growth
  - (d) A firm's decision about how many workers to hire
  - (e) The relationship between the inflation rate and changes in the quantity of money.
- In the light of above differentiate between micro and macro-economics.

**B.Tech. (FIFTH SEMESTER) EXAMINATION, DECEMBER 2022**

CS/IT/EI/EE

**PAPER MATH 311— Numerical Methods****TIME ALLOWED : THREE HOURS****Maximum Marks— 60**

*The question paper is divided into three Sections. Attempt six questions in all, selecting two questions from each Section. All questions carry equal marks.*

**Section A**

1. (a). Obtain the third degree polynomial expansion to  $f(x) = e^{3x}$  about  $x=0$ . Find the maximum error when  $0 \leq x \leq 0.5$  [5 Marks]  
 (b). Determine  $p; q$  and  $r$  so that the order of the iterative method

$$x_{k+1} = px_k + q \frac{a}{x_k^2} + r \frac{a^2}{x_k^5}, k = 0, 1, 2, \dots$$

to evaluate  $a^{1/3}$  becomes as high as possible. [5 Marks]

2. (a). Find the smallest positive real root of  $x - e^{-x} = 0$  using Bisection method correct upto two decimal places. [5 Marks]

- (b). Rearrange the following system of equations and solve using Doo-little method.

$$x + 5y - 9z = -12$$

$$x + 5y + 3z = 0$$

$$3x + y + 2z = 7.$$

[5 Marks]

3. (a). Let  $\phi(x) \in [a, b]$  such that  $\phi(x) \in [a, b]$ ,  $\forall x \in [a, b]$  and  $\phi'(x)$  exists on  $(a, b)$ . Prove that fixed point iteration scheme

$$x_{k+1} = \phi(x_k), k = 0, 1, \dots$$

converges to the unique fixed point in interval  $[a, b]$  if

$$|\phi'(x)| \leq 1, \quad \forall x \in (a, b).$$

- (b). Rearrange the following system of equations, if required, and solve using Gauss-Seidal method correct to three decimal places ( $1^{st}$  5 iterations only). [5 Marks]

$$2x + y + 9z = 12$$

$$8x + 2y - 2z = 8$$

$$x - 8y + 3z = -4$$

## Section B

separation of symbols to prove

$$\frac{x^3}{3!} + \dots = e^x \left[ u_0 + x \Delta u_0 + \frac{x^2}{2!} \Delta^2 u_0 + \frac{x^3}{3!} \Delta^3 u_0 + \frac{x^4}{4!} \Delta^4 u_0 + \dots \right] \quad [5 \text{ Marks}]$$

ing terms in the table

	:	0	2	4	6	8
$f(x)$	:	2	4	14	?	58

[5 Marks]

ating polynomial. Derive the Newton's interpolating  
tinct  $n + 1$  data points,  $(x_0, y_0); (x_1, y_1); \dots (x_n, y_n)$ . [5 Marks]

$$= \log \left[ 1 + \frac{\Delta f(x)}{f(x)} \right]$$

$x^3 + 2x^2 + 5x - 3$  into factorial notation.

[3 Marks]

[2 Marks]

ference table for the following data and hence Approximate  $y(1)$   
forward difference formula

[5 Marks]

:	0	2	4	6	8	10	12
:	1	3	7	12	15	22	25

; data find the value of  $x$  for which  $y = f(x)$  is minimum, also

[5 Marks]

:	0	1	2	3	4	5
:	1	-1	-1	1	5	11

## Section C

rule to evaluate  $\int_a^b f(x) dx$ . Also discuss the local and global error in

[5 Marks]

; data to evaluate  $I = \int_0^2 f(x) dx$ , where  $f(x) = 10x \sin x^2$ , using  
e.

ur result with the exact value of the integral  $I$ .

[5 Marks]

0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
0.64	2.11	4.78	8.14	11.90	12.95	8.79	-1.77	-15.14

8. (a) find the sequence of Picard's approximation to the solution of IVP

$$\frac{dy}{dx} = y - x, y(0) = 2.$$

Also find its exact solution and show that the sequence of Picard's approximation converges to the exact solution for  $|x| < 1$ . [5 Marks]

- (b). Approximate  $y(2)$  using Euler's method from

$$\frac{dy}{dx} = x \sin(x + y), y(1) = 1, \text{ take } h = 0.5$$

[5 Marks]

9. (a). Given  $\frac{dy}{dx} = x^2 y, y(1) = 2$ . Use 4<sup>th</sup> order Taylor Series method to find  $y(1.2)$ , taking  $h = 0.2$ . [5 Marks]

- (b). Write the initial value problem  $\frac{d^2y}{dx^2} = y + \frac{dy}{dx}, y(0) = 0, y'(0) = 1$  as a system of two first order equations. Hence, compute  $y(0.2)$ , using Runge Kutta second order method with  $h = 0.2$ . [5 Marks]

## B.Tech. (CS/IT) (V Sem.)

CS 302

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### B.Tech. (FIFTH SEMESTER) EXAMINATION, DECEMBER 2022

#### (COMPUTER SCIENCE / INFORMATION TECHNOLOGY)

##### PAPER CS 302—Data Communications and Networks

TIME ALLOWED : THREE HOURS  
Maximum Marks—60

This paper is divided into three Sections. Students are required to attempt six questions in all, selecting two questions from each Section.  
All questions carry equal marks.

##### SECTION A (i)

1. (a) Which device takes data sent from one network device and forwards it to all devices on the network regardless of the intended recipient?  
(b) You have 10 users plugged into a hub running 10 Mbps half-duplex. There is a server connected to the switch running 10 Mbps half-duplex as well. How much bandwidth does each host have to the server?
- 2.
- 3.

Turn over

(c) Compare and contrast various guided media on factors :  
data rates, BER, EMI/RFI, Cost, Frequency, Range and  
Applications.

2. (a) For the bit stream- 1110111000101, sketch the wave-forms for the following codes:-

\* NRZ-L, NRZ-I

\* Manchester

\* Differential Manchester.

(b) Why is multiplexing and demultiplexing needed in network? Explain FDM and TDM and their usage.

3. (a) An analog voice signal band limited to 4 kHz is sampled at Nyquist rate and then quantized at 256 levels.

(i) Find the sampling rate  $f_s$  and the sampling interval  $T_s$ .

(ii) Assuming the equally likely case (each level appears with equal probability), find the information content ( $H$ ) per interval (sample interval).

(b) A non-periodic composite signal contains frequencies from 10 to 40 kHz, the peak amplitude is 12 V for the lowest and the highest signals and is 30 V for the 20 kHz signal. Assuming that amplitude changes gradually from minimum to maximum, draw the frequency spectrum.

725

2

4

725

6. (a) Using Dijkstra's algorithms find the shortest path of

Turn over

3

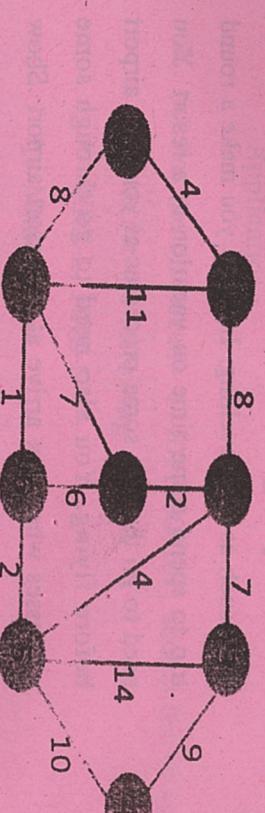
SECTION B

4. (a) Protocol layering can be found in many aspects of our lives such as air travelling. Imagine you make a round trip to spend some time on vacation at a resort. You need to go through some processes at your city airport before flying. You also need to go through some processes when you arrive at the resort airport. Show the protocol layering for the round trip using some layers such as baggage checking/claiming, boarding/unboarding, takeoff/landing.
- (b) Calculate the maximum link utilization efficiency for Stop & Wait Flow Control Mechanism if bit rate is 4800 bps, frame size is 2400 bits, distance between the devices is 2000 km. Speed of propagation over the transmission media can be taken as 200,000 km/sec.
- 5
5. (a) Generate CRC code for the data words 110101010 using the divisor 10101. The code word is received as a polynomial of  $x^{12} + x^{11} + x^8 + x^5 + x^4 + 1$ . Check if there are errors present in the code word.
- (b) Give the significance of packet size in a packet switching network. What types of delays are significant in assessing the performance of packet switched network?
- 5
6. (a) Using Dijkstra's algorithms find the shortest path of

following network from Router 0 to Router 4.

Determine the least cost path also.

5



(b) Differentiate between the following:-

- (i) Datagram and Virtual Circuit Switching
- (ii) Selective Repeat ARQ and Go-Back-N ARQ.

5

### SECTION C

7. (a) Explain TCP connection in brief. Give significance of

flags SYN, ACK, PSH, RST and FIN. In TCP, how do we define the sequence number of a segment? Show with example.

6

(b) UDP is a message-oriented protocol. TCP is a byte-oriented protocol. If an application needs to protect the boundaries of its message, which protocol should be used, UDP or TCP?

2

- (c) Can we have a data-transfer connection without a control connection in FTP? Explain.

2

8. (a) When an HTTP server receives a request message from an HTTP client, how does the server know when all

headers have arrived and the body of the message is to follow?

5

(b) Alice and Bob exchange confidential messages. They share a very large number as the encryption and decryption key in both directions. Is this an example of symmetric-key or asymmetric-key cryptography? Explain.

3

9. (a) Explain need of addressing scheme. Given a network address is 148.75.0.0/26.

- (i) What is an address class of this network?
- (ii) What is subnet mask of this network?
- (iii) How many hosts are there per subnet?
- (iv) How many subnets are created?

5

(b) Using the CIDR notation, show the IPv6 address compatible to the IPv4 address 129.6.12.34.

5

**B.Tech. (CS/IT) (V Sem.) / MCA / M.Sc.(CS) (I Sem.)**

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CS 308

**B.Tech. (CS/IT) (FIFTH SEMESTER) / MCA / M.Sc. (CS) (I Sem.) EXAMINATION,  
DECEMBER 2022**

**PAPER CS 308— Operating Systems**

**TIME ALLOWED : THREE HOURS**

**Maximum Marks— 60**

*Attempt six questions in all, selecting two questions from each Section.  
All questions carry equal marks.*

**SECTION A**

1. (a). Discuss Readers Writers problem and its solution using Semaphores. [3 marks]  
(b). Differentiate between Parallel and distributed processing. [3 marks]  
(c). Differentiate between Critical section and Remainder Section, with examples for each. [4 marks]

2. Consider the following set of processes, with the length of the CPU burst given in milliseconds:

Process	Burst Time	Priority
P1	10	3
P2	1	1
P3	2	3
P4	1	4
P5	5	2

The processes are assumed to have arrived at time 0.

- a. Draw four Gantt charts that illustrate the execution of these processes using the following scheduling algorithms: FCFS, SJF, non preemptive priority (a smaller priority number implies a higher priority), and RR (quantum = 2). [4 marks]

- b. What is the turnaround time of each process for each of the scheduling algorithms in part a? [2 marks]

- c. What is the waiting time of each process for each of the scheduling algorithms in part a? [2 marks]

- d. Which of the algorithms in part (a) results in the minimum average waiting time (over all processes)? [2 marks]

3. Consider a system with five processes P0 through P4 and three resources types a, B, C. Resource type A has 10 instances, B has 5 instances and type C has 7 instances. Suppose at time  $t_0$  following snapshot of the system has been taken:

Process	Allocation	Max	Available

P0 P1	A 0	B 1	C 0	A 7	B 5	C 3	A 3	B 3	C 2
P2	2	0	0	3	2	2			
P3	3	0	2	9	0	2			
P4	2	1	1	2	2	2			
	0	0	2						

- a. What will be the content of the Need matrix? [2 marks]  
 b. Is the system in safe state? If Yes, then what is the safe sequence? [4 marks]  
 c. What will happen if process P<sub>1</sub> requests one additional instance of resource type A, and two instances of resource type C? [4 marks]

### SECTION B

4. (a). Discuss paging and segmentation? [4 marks]  
 (b). What is thrashing? Explain with example. [3 marks]  
 (c). Differentiate between Demand paging and pure paging. [3 marks]

5. (a). Given 3 frames, find the number of page faults for the following page sequence for
- a. FCFS (First come first serve) algorithm. [3 marks]
  - b. Optimal algorithm. [3 marks]
  - c. LRU algorithm. [4 marks]

1	2	3	7	4	1	2	2	3	4	1	7	4	1	2	3	7	4	1	1
---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

6. Suppose that a disk drive has 5,000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The queue of pending requests, in FIFO order, is:  
**86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130**  
 Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all the pending requests for each of the following disk-scheduling algorithms?  
 a. FCFS, b. SSTF  
 c. SCAN d. LOOK [2x5 marks]  
 e. C-SCAN

### SECTION C

7. (a). What is the need of input output management in an operating system? Discuss. [4 marks]  
 (b). What is an interrupt? Discuss its types. [3 marks]  
 (c). Differentiate between parallel and distributed system. [3 marks]
8. (a). What is a hypercube system. Mention its properties and draw a hypercube system of degree 3. [4 marks]  
 (b). How is bus-oriented system different from crossbar connected system. [3 marks]  
 (c). What is the role of access and capability list in an operating system? [3 marks]

9. (a). What is an Inode? Discuss. [3 marks]  
(b). Discuss the "chmod" command with example. [3 marks]  
(c). Differentiate between Windows and Unix. [4 marks]

