CBCS SCHEME

USN | | | | | | | | | | |

18ME61

# Sixth Semester B.E. Degree Examination, June/July 2024
## Finite Element Methods

Time: 3 hrs. Max. Marks: 100

**Note:** ***Answer any FIVE full questions, choosing ONE full question from each module.***



### Module-1

1 a. List and explain general steps of Finite Element Methods. **(10 Marks)**

b. A bar of length L, cross section area A and modulus of elasticity E, is subjected to distributed load q = CX, where C is constant as in Fig Q1(b). Determine the displacement of bar at end using R-R method.

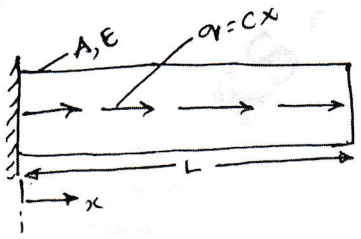


Fig Q1(b) **(10 Marks)**

**OR**

2 a. Explain different types of elements in Finite Element Method. **(05 Marks)**

b. Explain simplex, complex and multiplex elements. **(05 Marks)**

c. Using Galeskin's method find the expression for displacement of cantilever beam as shown in Fig Q2(c)

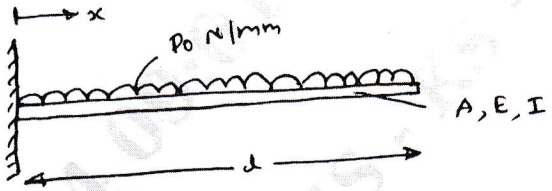


Fig Q2(c) **(10 Marks)**

### Module-2

3 a. Derive shape functions for C.S.T element. **(10 Marks)**

b. Derive shape function for TET – 4 elements. **(10 Marks)**

**OR**

4 Determine the stresses in members of structure given in Fig Q4. Using penalty approach method.

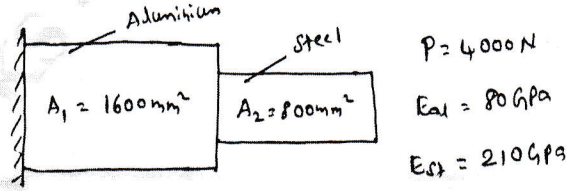


Fig Q4 **(20 Marks)**

## Module-3

5 a. Derive Hermite shape functions for beam element. **(10 Marks)**

b. Fig Q5(b) shows a simply supported beam subjected to U.D.L to obtain max, deflection. Take E = 200GPa, I = $2 \times 10^6 mm^4$.

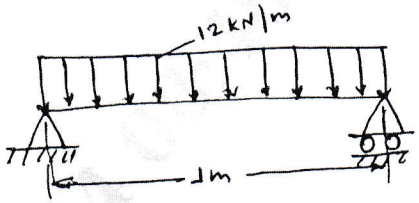


Fig Q5(b) **(10 Marks)**

**OR**

6 a. Derive an equation for stiffness matrix for Torsion bar. **(10 Marks)**

b. A solid stepped bar of circular C/S as in figure is subjected to torque as shown in Fig Q6(b). Determine angle of twist and shear stresses in bar E = $2 \times 10^5 N/mm^2$, G = $7 \times 10^4 N/mm^2$.

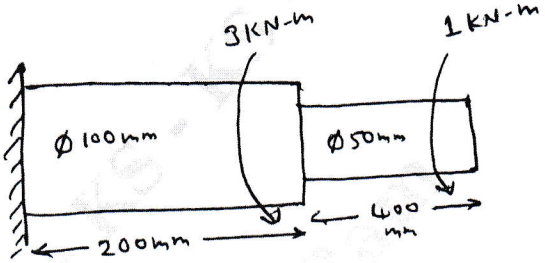


Fig Q6(b) **(10 Marks)**

## Module-4

7 a. Derive an differential equation for 1D heat conduction. **(10 Marks)**

b. Find the temperature distribution in 1D fin as shown in Fig Q7(b)

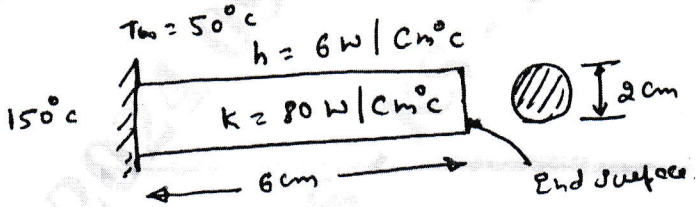


Fig Q7(b) **(10 Marks)**

**OR**

8 a. Derive 2D fluid flow for porous medium differential equation. **(10 Marks)**

b. For the smooth pipe shown in Fig Q8(b) with uniform C/S of $1m^2$ determine the flow velocities at the centre and right end, knowing velocity at left $V_x$ = 2m/sec.

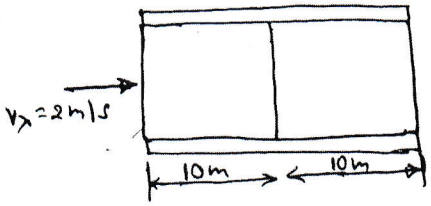


Fig Q8(b) **(10 Marks)**

## Module-5

9 a. Derive strain displacement matrix for axi-symeric element. **(10 Marks)**

b. Evaluate nodes forces used to replace the linearly varying surface traction as in Fig. Q9(b)

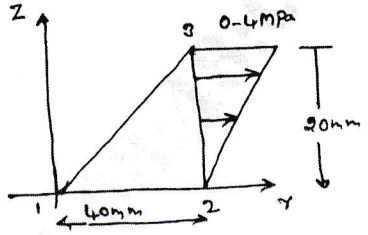


Fig Q9(b) **(10 Marks)**

**OR**

10 Evaluate eigen vectors and eigen values for the stepped bar shown in Fig Q10. Take E = 200GPa and specific weight 7850 kg/m$^3$. Draw mode shapes, $A_1$ = 400mm$^2$, $A_2$ = 200mm$^2$.

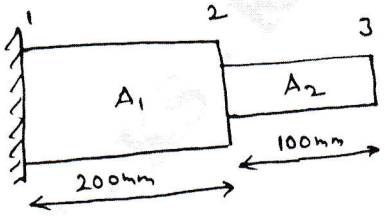


Fig Q10 **(20 Marks)**

* * * * *

CBCS SCHEME

USN | | | | | | | | | | |

18ME62

# Sixth Semester B.E. Degree Examination, June/July 2024
## Design of Machine Elements – II

Time: 3 hrs. Max. Marks: 100

*Note:* 1. *Answer any FIVE full questions, choosing ONE full question from each module.*
2. *Use of design data book is permitted.*



### Module-1

1 a. Briefly explain the construction and applications of Timing belts. **(06 Marks)**

b. Design a helical compression spring for a service load ranging from 2250 N to 2750 N. The axial deflection of the spring for the above load range is 6 mm. Taking the spring index as 5 design the spring for a permissible stress of 420 MPa. Assume modulus of rigidity $G = 84\ kN/m^2$. **(14 Marks)**

**OR**

2 a. Explain the process of equalization of stresses in leaf springs. **(04 Marks)**

b. A pulley 200 mm diameter rotating at 900 rpm, has 6 grooves and drives another pulley of 500 mm diameter by means of V-belts of cross section C. The centre distance between pulleys is 1500 mm. The drive has to work for 12 hours/day under medium shock load. Find the power capacity of the drive. **(16 Marks)**

### Module-2

3 a. Derive an expression for formative number of teeth of a helical gear. **(06 Marks)**

b. Design a spur gear drive of steel to transmit 5 kW at 900 rpm. Allowable static stress for the material of the pinion is $\sigma_{d_1} = 200$ MPa and that of the gear is $\sigma_{d_2} = 140$ MPa. Diameter of the pinion is to be 100 mm. The centre distance of the drive is around 200 mm. The gear teeth are 20° FDI form. Service factor is to be 1.0. Determine the module and face width of the gears from the stand point of strength (Lewis equation). Check the design of gears for dynamic and wear strength. Assume class I, commercial gears for which consider dynamic load factor c = 572 N/mm. **(14 Marks)**

**OR**

4 a. Derive Lewi's equation for a spur gear. **(06 Marks)**

b. Design a pair of steel helical gears to transmit 18 kW from pinion rotating at 4000 rpm. The gear is to rotate at 800 rpm. The helix angle is 30°. The teeth are of 20° stub involute in diametral plane. Number of teeth on pinion is 20. Allowable static stress for material of pinion and gear is 51.7 MPa. Design the gear from the stand point of strength. Check the design for dynamic and wear strength. Take $C_S = 1.5$. Take dynamic load factor as C = 240 N/mm. **(14 Marks)**

### Module-3

5 A pair of straight tooth bevel gears at right angles is to transmit 5 kW at 1200 rpm of pinion. Pinion diameter is 80 mm and the velocity ratio is 3.5:1. The tooth form is $14\frac{1}{2}^\circ$ composite. Both pinion and gear are of cast-iron with $\sigma_d = 55\ MN/m^2$.

(i) Determine the face width and the required module from the stand point of strength using Lewi's equation. Take $C_S = 1.0$.

(ii) Check the design for dynamic and wear strength. Take dynamic load factor C = 139.7 N/mm. **(20 Marks)**

**OR**

6 Design a worm gear drive to transmit 18 kW from a worm rotating at 1440 rpm to a worm wheel to rotate at 40 rpm. Assume 20° FDI form, service factor CS = 1.5. Worm is made of hardened steel while gear is of phosphor Bronze material with an allowable static stress of 103.5 MPa. Gear temperature is 60°C and ambient temperature is 30°C. Check the heating capacity of the drive and also calculate the efficiency of the worm gear drive. **(20 Marks)**

## Module-4

7 a. Derive an expression for torque transmission capacity of a cone clutch according to uniform wear theory. **(10 Marks)**

b. A multiple plate clutch has 2 bronze and 3 steel discs. The friction material can withstand a pressure of 0.1 N/mm$^2$ and coefficient of friction = 0.15. The outside and inside diameters of friction lining are 200 mm and 120 mm respectively. Determine the power transmitted by the clutch at 1000 rpm. **(10 Marks)**

**OR**

8 A single block brake with a torque capacity of 250 N-m is shown in Fig.Q8. The brake drum rotates at 100 rpm. Coefficient of friction is 0.35. Calculate:

(i) Actuating force and hinge pin reactions for clockwise rotation of the drum.
(ii) Actuating force for counterclockwise rotation of the drum.
(iii) The rate of heat generated during braking action.
(iv) Dimensions of shoe block if the allowable bearing pressure is 1 N/mm$^2$. The length of the block is twice its width.

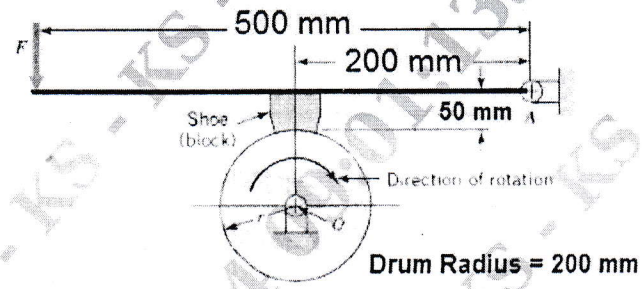


Fig.Q8 **(20 Marks)**

## Module-5

9 a. Mention the advantages and disadvantages of rolling contact bearings. **(06 Marks)**

b. A 75 mm long full journal bearing of diameter 75 mm supports a radial load of 12 kN at the shaft speed of 1800 rpm. Assume ratio of diameter to the diametral clearance as 1000. The viscosity of oil is 0.01 Pa.S at the operating temperature. Determine the following:

(i) Sommerfeld number
(ii) Coefficient of friction based on McKee's equation
(iii) Amount of heat generated **(14 Marks)**

**OR**

10 a. Derive an expression for coefficient of friction in a hydrodynamic bearing based on Petroff's equation. **(08 Marks)**

b. A ball bearing running at 900 rpm is subjected to a radial load of 2 kN and a thrust load of 1.2 kN. The bearing is in use for 10 hours per day, 6 days in a week for 3 years at 95% reliability. Determine the size of medium series ball bearing that can be used for the above loading condition. **(12 Marks)**

* * * * *

CBCS SCHEME

USN | | | | | | | | | | |

18ME63

# Sixth Semester B.E. Degree Examination, June/July 2024
## Heat Transfer

Time: 3 hrs. Max. Marks: 100

***Note:*** **1.** ***Answer any FIVE full questions, choosing ONE full question from each module.***
**2.** ***Use of Heat Transfer Data handbook permitted.***



### Module-1

1 a. Explain with suitable sketches, the 1st, 2nd and 3rd kind of boundary conditions. **(06 Marks)**

b. Explain briefly:
(i) Thermal conductivity
(ii) Thermal diffusivity
(iii) Thermal contact resistance **(06 Marks)**

c. A mild steel tank of wall thickness 20 mm is used to store water at 95°C. Thermal conductivity of mild steel is 45 W/m-°C, and the heat transfer coefficient inside and outside the tank are 2850 W/m$^2$-°C and 10 W/m$^2$-°C respectively. If the surrounding air temperature is 20°C, calculate the rate of heat transfer per unit area of the tank. **(08 Marks)**

**OR**

2 a. Derive an equation for critical thickness of insulation in cylinder. **(06 Marks)**

b. A small spherical vessel of outside diameter 60 mm is covered with as asbestos (K = 0.1105 W/m-K) and left in the atmospheric air at 30°C. The film coefficient between air and asbestos is 5 W/m$^2$-K. If it is desired to maximize the heat transfer rate from the contents of the vessel to the air, determine the thickness of asbestos cover needed and also the rate of heat flow at this thickness if the surface the vessel to be maintained at 120°C. **(06 Marks)**

c. An insulated steam pipe having outside diameter of 30 mm is to be covered with two layers of insulation each having a thickness of 25 mm. The average thermal conductivity of one material is 5 times that of the other. Assuming that the inner and outer surface temperatures of composite insulation are fixed, how much will the heat transfer be reduced when the better conducting material is next to the pipe than it is outer layer? **(08 Marks)**

### Module-2

3 a. Derive the expression for temperature distribution and rate of heat transfer from a fin when its end is insulated. **(10 Marks)**

b. A handle of a ladle used for pouring molten lead at 327°C is 30 cm long and is made of 2.5 cm × 1.5 cm mild steel bar stock (K = 43 W/m-K). In order to reduce the grip temperature, it is proposed to make a hallow handle of mild steel plate 1.5 mm thick to the same rectangular shape. If the surface heat transfer coefficient is 14.5 W/m$^2$-K and the ambient temperature is 27°C, estimate the reduction in the temperature of the grip. Neglect the heat transfer from the inner surface of the hallow shape. **(10 Marks)**

**OR**

4 a. Derive the expression for temperature distribution and heat flow using lumped parameter analysis in transient heat conduction. **(10 Marks)**

b. A 50 mm thick iron plate [K = 60 W/m-K, $\rho$ = 7350 kg/m$^3$, $C_p$ = 460 J/kg-K] is initially at 225°C. Suddenly the plate is immersed in a fluid medium maintaining at a uniform temperature of 25°C with a surface heat transfer coefficient of 500 W/m$^2$-K. Calculate:
(i) The temperature at the centre of the plate 2 minutes after the start of cooling
(ii) Temperature at a depth of 10 mm from plate surface 2 minutes after the start of cooling
(iii) Temperature at the plate surface 2 minutes after the start of cooling
(iv) The energy removed from the plate per m$^2$ during this time. **(10 Marks)**

## Module-3

5 a. Explain implicit and explicit method for discretization of 1-dimensional transient heat conduction problem. **(08 Marks)**

b. An iron rod L = 5 cm long of diameter D = 2 cm with thermal conductivity K = 50 W/(m-°C) protrudes from a wall and is exposed to an ambient at $T_\infty$ = 20°C and h = 100 W/(m$^2$-°C). The base of the rod is at $T_0$ = 320°C and its tip is insulated. Assuming 1-D steady state heat flow, calculate the temperature distribution along the rod and the rate of heat flow into the ambient by using finite differences method.

Assume the initial guess for temperature as 200°C and the length of the fin is divided into 5 equal parts. **(12 Marks)**

**OR**

6 a. Define and explain the following:
(i) Kirchoff's law
(ii) Stefan Boltzman law
(iii) Wein's displacement law **(06 Marks)**

b. A furnace wall emits radiation at 2000 K. Treating it as black body radiation, calculate:
(i) Manochromatic radiant flux density at 1 μm wave length
(ii) Wavelength at which emission is maximum and the corresponding emissive power
(iii) Total emissive power **(06 Marks)**

c. Emissivities of two large parallel plates maintained at 800°C and 300°C are 0.3 and 0.5 respectively. Find the net radiant heat exchange per m$^2$ for these plates. Find the percentage reduction in heat transfer when a polished aluminium radiation shield of emissivity 0.06 is placed between them. Also find the temperature of the shield. **(08 Marks)**

## Module-4

7 a. Explain with neat sketches: (i) Velocity boundary layer (ii) Thermal boundary layer **(06 Marks)**

b. Atmospheric air at 300 K flow with a velocity of 5 m/s, along a flat plate of length 1m long. The plate has a width of 0.5 m. The total drag force acting on the plate is determined to be $18 \times 10^{-3}$ N. By using the Reynold's-Colburn analogy, estimate the average heat transfer coefficient for flow of air over the plate. **(06 Marks)**

c. Water flows with a mean velocity of 2 m/s inside a circular pipe of inside diameter 5 cm. The pipe is considered to be a smooth pipe and its wall is maintained at a uniform temperature of 100°C by condensing steam on its outer surface. At a location where the fluid is hydrodynamically and thermally developed, the bulk mean temperature of water is 60°C. Calculate the heat transfer coefficient by using:
(i) Dittus-Boelter equation
(ii) Sieder-Tate equation **(08 Marks)**

**OR**

8 a. Explain the physical significance of the following dimensionless numbers:
(i) Reynold's number (ii) Prandtl number
(iii) Nusselt number (iv) Grashof number **(08 Marks)**

b. Consider a square plate 0.5 m by 0.5 m with one surface insulated and the other surface maintained at a uniform temperature of 110°C which is placed in quiescent air at atmospheric pressure and 40°C. Calculate the average heat transfer coefficient for free convection for the following orientations of the hot surface:
(i) The plate is horizontal with hot surface faces up
(ii) The plate is horizontal with hot surface faces down
(iii) The plate is vertical **(12 Marks)**

## Module-5

9 a. Derive an expression for LMTD for parallel flow heat exchanger and the assumptions made. **(10 Marks)**

b. A cross flow heat exchanger with both threads unmixed having a heat transfer area of 8.4 $m^2$ is to heat air ($C_{pc}$ = 1005 J/kg-°C) with water ($C_{ph}$ = 4180 J/kg-°C). Air enters at 15°C with 2.0 kg/s, while the water enters at 90°C with 0.25 kg/s. The overall heat transfer coefficient is 250 W/$m^2$-°C. Calculate the exit temperatures of both air water as well as total heat transfer rate. **(10 Marks)**

**OR**

10 a. Explain different regimes of pool boiling with neat sketches. **(06 Marks)**

b. Saturated water at 100°C is boiled with a copper heating element having a heating surface of 500 sq.cm, which is maintained at a uniform temperature of 115°C. Calculate the surface heat flux and rate of evaporation. **(06 Marks)**

c. Air free saturated steam at $T_V$ = 85°C condenses on the outer surface of 225 horizontal tubes of 1.27 cm OD arranged in a 15-by-15 array. Tube surfaces are maintained at a uniform temperature $T_w$ = 75°C. Calculate the total condensation rate per meter length of the tube bundle. **(08 Marks)**

* * * * *

CBCS SCHEME

USN | | | | | | | | | | |

18ME641

# Sixth Semester B.E. Degree Examination, June/July 2024
## Non – Traditional Machining

Time: 3 hrs. Max. Marks: 100

**Note:** ***Answer any FIVE full questions, choosing ONE full question from each module.***



### Module-1

1 a. Define Non – Traditional Machining. Give classification of Non – Traditional Machining. **(06 Marks)**

b. Discuss the need for Non – Traditional Machining with invension of newer materials. **(05 Marks)**

c. Explain the criterias for the selection of Non – Traditional processes. **(09 Marks)**

**OR**

2 a. Explain with necessary sketch the mechanism of material removal in Ultrasonic Machining. **(08 Marks)**

b. Discuss the process parameters in Ultrasonic machining. **(06 Marks)**

c. List the advantages and disadvantages of Ultrasonic machining. **(06 Marks)**

### Module-2

3 a. Enumerate the difference between Traditional and Non – traditional Machining Processes. **(08 Marks)**

b. Discuss the process capability of any two Non – traditional Machining processes. **(06 Marks)**

c. List the advantages , disadvantages and application of Non – traditional processes. **(06 Marks)**

**OR**

4 a. Explain with a neat sketch, the working of Abrasive Jet Machining process. **(08 Marks)**

b. Explain with necessary sketches, various tool feed mechanisms used in Ultrasonic machining. **(06 Marks)**

c. Write a note on Slurry. **(06 Marks)**

### Module-3

5 a. Sketch and explain Electrochemical Machining process. **(06 Marks)**

b. Discuss the influence of process parameters in Electro Chemical Machining process. **(06 Marks)**

c. Explain with necessary sketch, Electrochemical Grinding process. **(08 Marks)**

**OR**

6 a. Explain with a flow chart, the principal process steps for chemical Blanking. **(08 Marks)**

b. Explain with a flow chart, chemical milling process. **(06 Marks)**

c. List the functions of Electrolyte. **(06 Marks)**

### Module-4

7 a. With necessary sketch, explain the mechanism of metal removal in EDM process. **(06 Marks)**

b. Explain with neat sketches, the Flushing techniques in EDM process. **(08 Marks)**

c. Explain with neat sketch, the Electrode feed control used in EDM process. **(06 Marks)**

**OR**

8 a. With a neat sketch, explain the mechanism of metal removal in Plasma Arc Machining. **(10 Marks)**

b. Discuss the Accuracy and surface limits in Plasma Arc Machining. **(04 Marks)**

c. List the advantages and limitations of Plasma Arc Machining process. **(06 Marks)**

## Module-5

9 a. Sketch and explain the mechanism of metal removal in Laser beam machining. **(08 Marks)**

b. Explain with necessary sketch the generation of Ruby Laser. **(06 Marks)**

c. List the advantages , limitations and application of Laser Beam Machining. **(06 Marks)**

**OR**

10 a. Explain with a neat sketch, the material removal in Electron beam machining. **(08 Marks)**

b. Discuss the effect of process parameters in Electron beam machining. **(06 Marks)**

c. List the advantages , limitations and application of Electron beam machining. **(06 Marks)**

* * * * *

CBCS SCHEME

USN | | | | | | | | | | |

18ME653

# Sixth Semester B.E. Degree Examination, June/July 2024
## Supply Chain Management

Time: 3 hrs. Max. Marks: 100

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*



### Module-1

1 a. Define Supply Chain. Explain evolution of supply chain through the three major revolutions. (10 Marks)

b. Explain how the various decision phases in supply chain management helps in increasing the surplus. (10 Marks)

OR

2 a. Explain the impact of different drivers on the performance of the supply chain. (10 Marks)

b. Explain the various categories of supply chain strategies. (10 Marks)

### Module-2

3 a. What are the conditions for a successful contract? Explain the risks of using a third party in a supply chain. (10 Marks)

b. Explain Kraljic's portfolio method if classifying items for sourcing. (10 Marks)

OR

4 a. Define outsourcing. Explain the strategic sourcing process with advantages and disadvantages of sourcing. (10 Marks)

b. Explain with examples, vertical and tapered integration in a supply chain. (10 Marks)

### Module-3

5 a. Define Stores management. What are the major functions of the stores? (10 Marks)

b. Explain the various ways of carrying out inspection for incoming materials. (10 Marks)

OR

6 a. Explain the various factors influencing the options of distribution network design. (10 Marks)

b. Explain the measures which can improve warehouse efficiency. (10 Marks)

### Module-4

7 a. What is the framework for network design decisions? Explain the impact of uncertainty on network design with an example. (10 Marks)

b. Define demand planning and state its importance. Explain the various aspects of demand planning. (10 Marks)

OR

8 a. Define pricing and explain fixed pricing and menu pricing. What are the various metrics related to pricing? (10 Marks)

b. What is multiple item-multiple location inventory management? Explain the challenges and advantages of multi-location inventory management. (10 Marks)

## Module-5

9 a. Define Supply Chain Integration. What are the different stages of supply chain integration? **(10 Marks)**

b. Define Bullwhip effect. What are the prominent causes and effects of Bullwhip effect? **(10 Marks)**

OR

10 a. Explain reverse logistics and the scenarios under which a product enters back into the supply chain. What are the characteristics of reverse supply chain network? **(10 Marks)**

b. Describe E-business and classify them. Explain the role of E-commerce in supply chains. **(10 Marks)**

* * * * *